LISTA DE MISILES BALISTICO

Popeye (AGM-142)

Air-to-Surface Standoff Missile

Popeye is RAFAEL's primary standoff capable missile and offers effective precision attack capability against high value land and maritime targets. Effective against bunkers, missile sites and other high-value targets, Popeye uses multiple guidance modes, either imaging infrared or TV, in the terminal mode, to provide precision attack and destruction of well protected targets. Popeye is operational on F-4, F-15, B-52 and F-111s with several air forces, including Israel's air force, USAF and the Royal Australian Air Force, where it is designated "Have Nap".

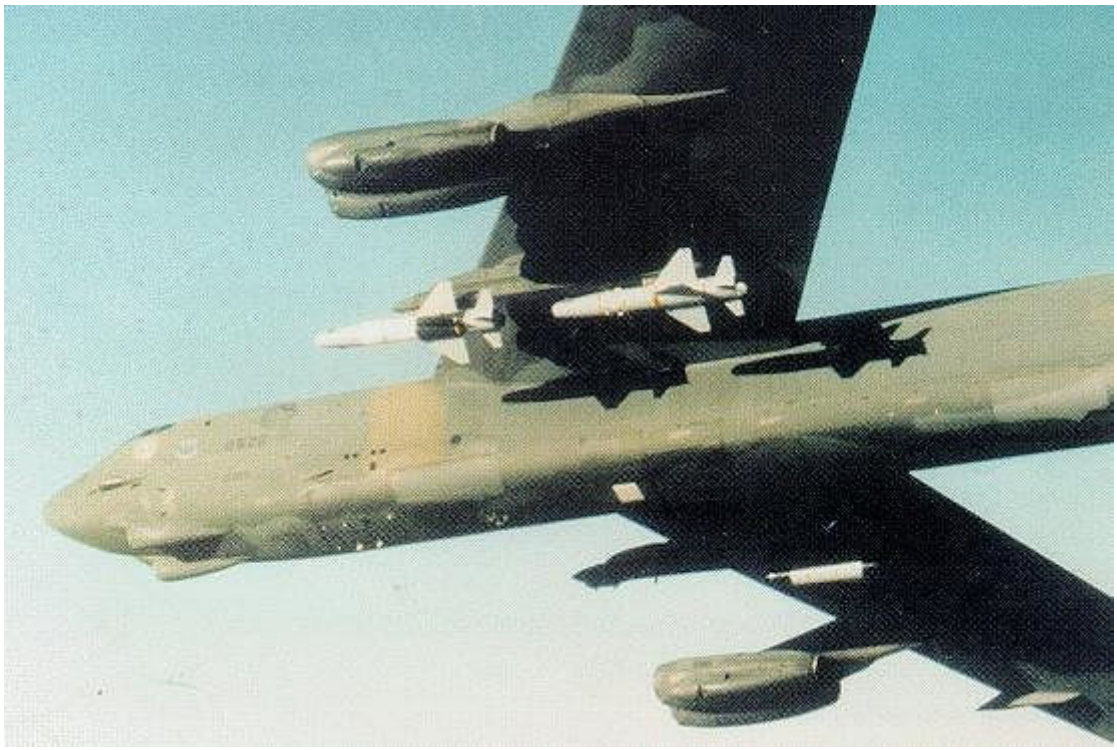
Precise strike capability has become critical for modern air warfare. RAFAEL's wide variety of sophisticated solutions serves to enhance the operational capabilities of aircraft with highly accurate guided standoff systems including the Popeye, Popeye Lite (Have Lite) missiles. Popeye is operational with the Israeli Air Force, as well as other advanced air forces feature RAFAEL's air-to-surface missiles in their arsenals.

Main Features

Standoff ranges - effective against high value land and maritime targets
Versatile and cost-effective
Pinpoint accuracy, lethal efficiency
Day, night and adverse weather operation
Penetration capability
Battle Damage Assessment (BDA) capability
Variety of trajectories to meet weather and threat conditions

Turkey initially bought 50 Popeye I missiles for its fleet of F-4s being upgraded at Israel Aircraft Industries. At least 40 Popeye I missiles were delivered to Turkey in 1997 with a second batch of 60 shipped in 1998.

The Popeye II missiles were expected to be delivered beginning in 2000. The overall Popeye-I and Popeye-II missiles program with Turkey was valued at some $500 million.



In 1988, Popeye was selected by the USAF for the Have Nap program to improve the non-nuclear capabilities of the B-52G/H. The Air Force designated the missile as AGM-142A and assigned the name Raptor . However, the latter had to be dropped after the same name had been selected for the F-22 (now F/A-22) Advanced Technology Fighter, and the AGM-142 is now generally known by the program name Have Nap . The Have Nap became operational with the USAF in 1992. The missile is powered by a solid-fuel rocket motor in the WPU-14/B propulsion section. Its 340 kg (750 lb) blast-fragmentation warhead is triggered by a tail-mounted FMU-124C/B impact fuze. Accuracy is quoted to be around 3 m (10 ft) CEP. Unarmed training versions include the ATM-142A , the captive-carry CATM-142A and the DATM-142A for ground handling training.

Category	Air-to-Surface
Manufacturer	Rafael Armaments
City	Haifa, Israel
Length	480 cm
Span	200 cm

Weight	1380 kg
Guidance	Rafael
Guidance Type	IIR/TV/Data link/INS
Model	spr.
Range	110+ km
Status	Operational in Israel 1985, operational on

Popeye Lite (Have Lite)

A Popeye Air-to-Surface Version for Lighter Aircraft

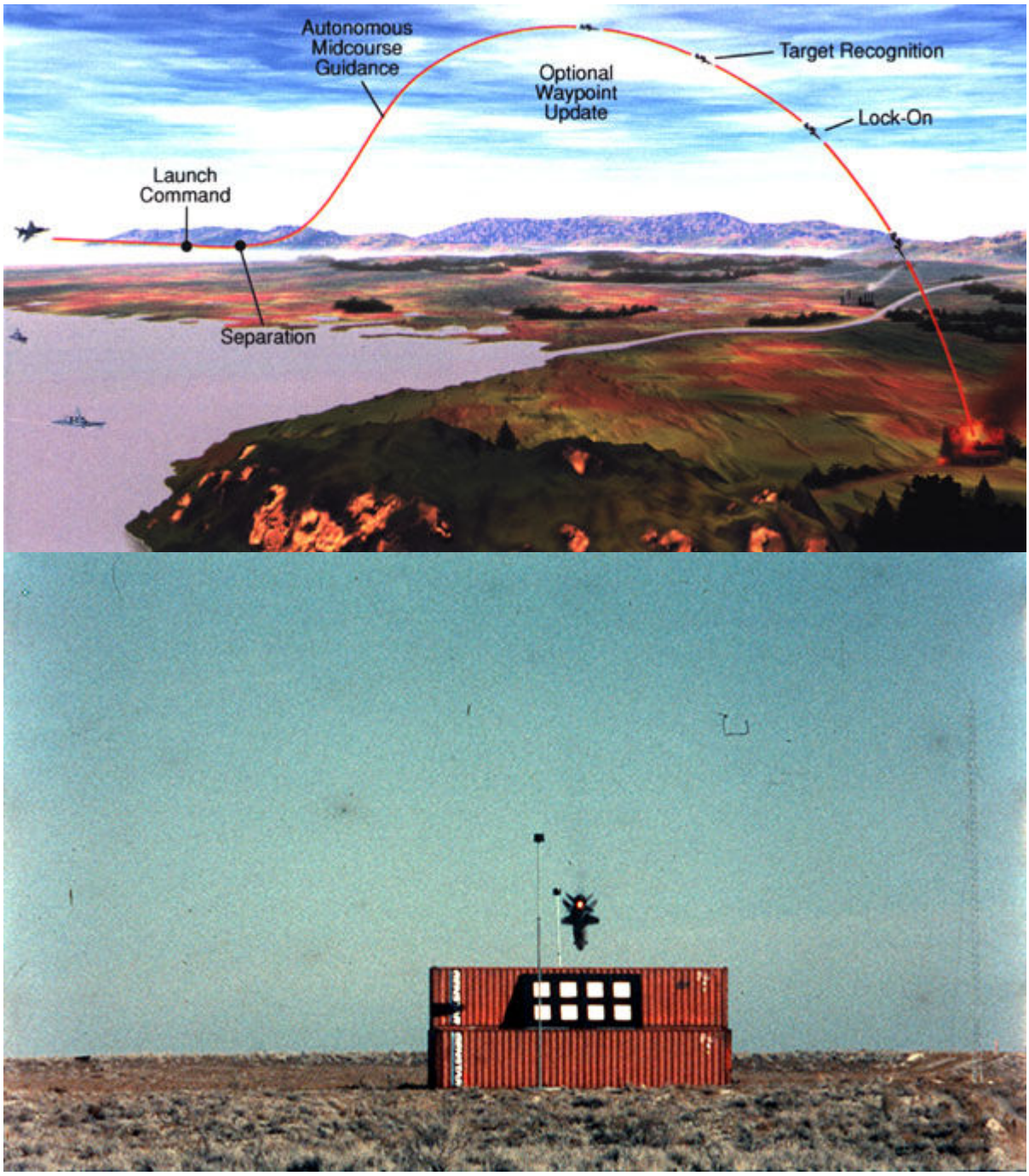
LOCKHEED MARTIN

Popeye-Lite, a new version of the Popeye, Air-to-Surface standoff missile is adapted for lighter aircraft such as the F-16.

Have Lite is an advanced air-to-ground precision guided missile. Have Lite is marketed by PGSUS, a joint venture of Lockheed Martin and Rafael. With Have Lite, fighter aircraft can attack and destroy high-value ground and sea targets from long range, including bunkers, power plants, missile sites, bridges, and ships. Multiple guidance modes and options provide lethal accuracy, allowing a building's doorway to become a legitimate target. Accurate and cost effective, the missile system has a very high proven hit probability. Have Lite, with its flexible mission planning and significant standoff range, minimizes fighter aircraft exposure. It can be programmed to fly various horizontal and vertical trajectories and employs autonomous midcourse guidance based on GPS-aided inertial navigation. The missile then homes in on the target using a high-performance IIR or TV seeker and delivers either

penetration or blast fragmentation warheads with surgical precision.

Have Lite is a reduced size and weight version of the AGM-142. It gives fighter aircraft precision standoff capability. The missile features low and high altitude launch trajectories, and is highly survivable, especially in terminal phase. The trminal man-in-the-loop control provides for pinpoint accuracy. High reliability and availability are supported by high-performance IIR and TV seekers that are line replaceable units. The blast fragmentation or penetrating warheads are effective against hard or soft targets.



HAVE LITE is the reduced size and weight version of the AGM-142.

Brings precision standoff capability to single seat fighter aircraft.

Terminal man-in-the-loop control ensures pinpoint accuracy, minimizing collateral damage.

High impact velocity and programmable impact angle, combined with missile accuracy, provide the highest probability of kill for hard and soft targets.

GPS-aided mid-course inertial navigation feature reduces operator workload. It also incorporates operator-selected trajectory shaping, which requires minimal crew input until final aimpoint selection in terminal mode (90 percent silent to target).

Cost encompasses missile, data link pod, and integrated logistics support.

Same aircraft interfaces as AGM-142, specifically on the B-52, F-111,F-4, and F-15. Targeted aircraft include F-16, Mirage 2000, Kfir, and A-4.

Selected by multiple world-class air forces and totally supportable via the well-established USAF integrated logistics currently in place for the AGM-142, as well as the support facilities in Israel .

Operational and maintenance training capability mirrors that of the established and proven AGM-142 capability.

Integral solid rocket motor is expended well before impact, providing low noise and low IR signature. This feature, combined with trajectory shaping, significantly enhances survivability in the terminal phase.

U.S. production capabilities at Lockheed Martin Pike County Operations in Troy , Alabama takes advantage of AGM-142's production rate of 200 weapons per year.

The PGSUS joint venture team of Lockheed Martin and Rafael combines the strength of both companies to provide a high quality system.

Low aircraft integration cost and short integration schedule on fighter aircraft.

Main Features

Standoff ranges - effective against high value land and maritime targets
Versatile and cost effective
Pinpoint accuracy, lethal efficiency
Day, night and adverse weather operation
Battle Damage Assessment (BDA) capability
Variety of trajectories to meet weather and threat conditions.

ET
40 FTS
PGSUS LLC
HAVE LITE

In 26.11.2002 the first flight of the Have-Lite (a lightweight version of the Popeye standoff precision attack missile) was successfully conducted by Lockheed Martin and RAFAEL, as a U.S. Air Force F-16 pilot launched the missile and controlled the weapon to a high precision hit, while flying the aircraft.

Lockheed Martin successfully conducted the first flight test of the lightweight version of the RAFAEL Popeye missile designated Have Lite, demonstrating the ability of a U.S. Air Force F-16 pilot to launch and control the weapon while also flying the aircraft. In the test, conducted at the Utah Test Range in Ogden, Utah, the missile struck a stationary target, proving it could follow a planned mission route. "We're extremely pleased with the results of this test," said Randy Bigum, vice president of Strike Weapons at Lockheed Martin Missiles and Fire Control. "Have Lite will enable our international customers to strike high-value ground and sea targets from long range. Since Have Lite is designed to work from fighter aircraft, it opens up a heavy strike capability without the need for heavy aircraft."

In this test, the missile was launched from a single seat U.S. Air Force F-16, flying 0.7 mach at an altitude of 8,700 feet. After weapon release, the missile flew a straight path using Global Positioning System (GPS) guidance to locate the target area.

The aircraft then turned away from the target while maintaining data link with the missile. When in range, the F-16 pilot maneuvered the missile into the target using man-in-the-loop controls with the missile's terminal guidance TV seeker. As planned, the missile struck the target with an inert warhead.

In May 1997 Israel and Turkey agreed to jointly produce the Popeye 2 air-to-ground missile in a deal initially worth about $100 million dollars. The new deal involved a consortium to be established between two Turkish firms and Rafael to jointly produce the Popeye 2, a smaller missile with more

advanced technology. The Popeye 2, also known as the Have Lite, is designed for deployment on fighter aircraft and has a range of 150 kilometers. The Popeye 2 missiles were expected to be delivered beginning in 2000. The overall Popeye 1 and Popeye 2 missiles program with Turkey was valued at some $500 million.

In December 1999 press reports suggested the possibility of the sale of Popeye 2 missiles to India. US officials told Israel that they were concerned about sales of arms to India because of tensions in the region.

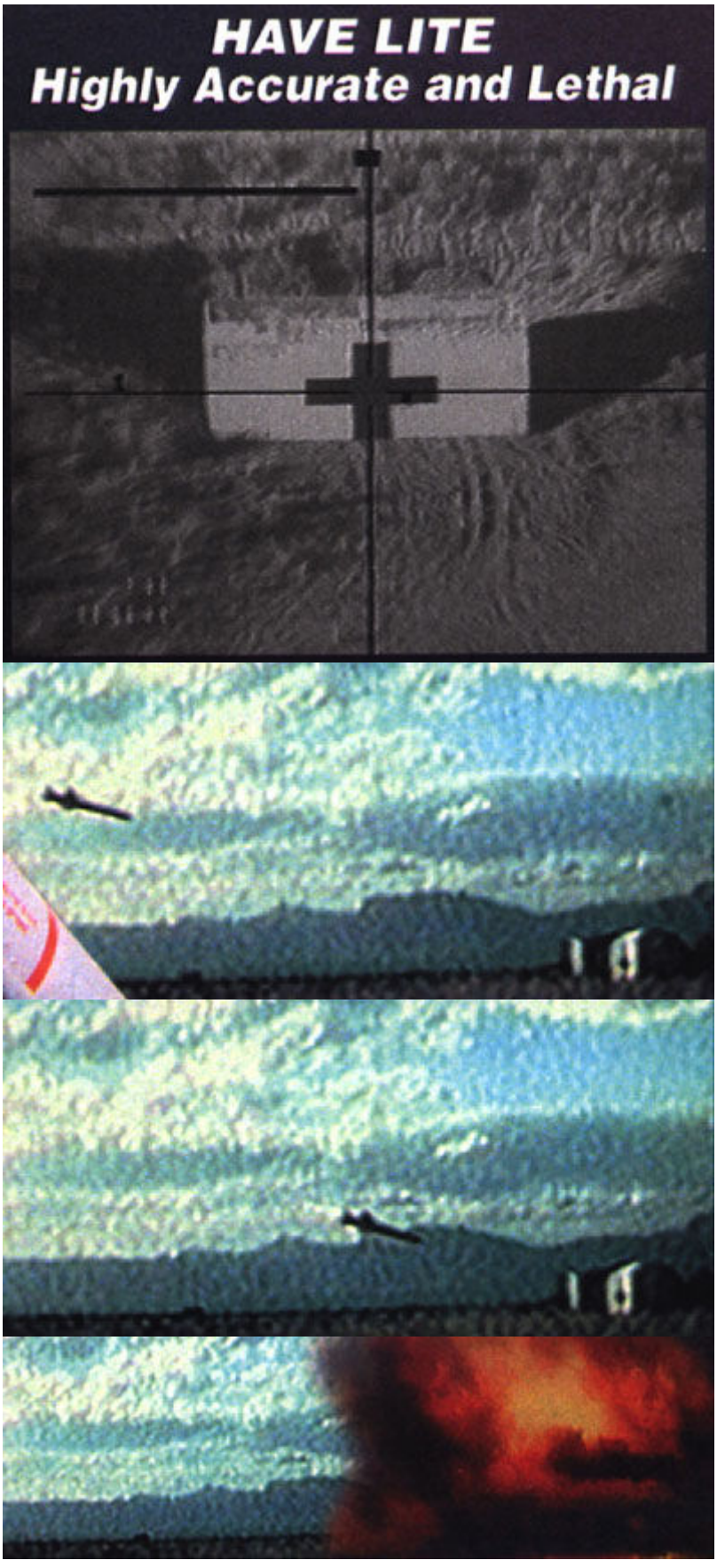
Specifications

Missile	
Guidance	GPS ai ded inertial
Midcourse	IIR or TV with man-in-the-loop
Terminal	
Propulsion	Solid Fuel
Length	424 cm (167 in)
Diameter	53cm (21 in)
Horizontal Span (max)	152 cm (60 in)
Vertical Span	107 cm (41 in)
Overall Weight	1125 kg (2500 lb)
Warhead Section	454 kg (1000 lb)
(Penetrator or Blast Fragmentation)	
Data Link Pod	

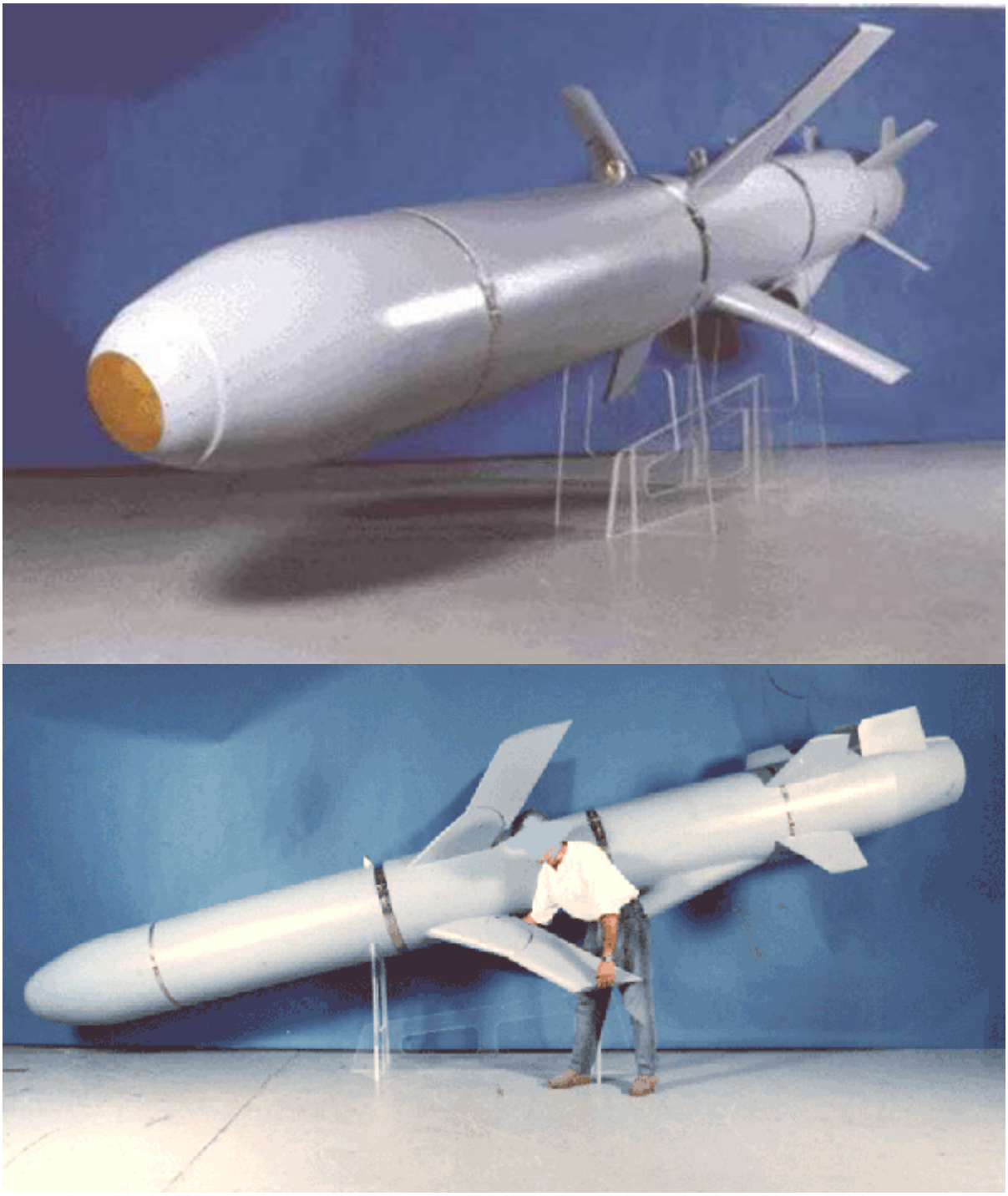
Weight	393 kg (865 lb)
Length	353 cm (139 in)
Diameter	53 cm (21 in)
Pointing Antenna	Narrow Beam

Characteristic

Characteristics	
Weight	1125 kg
Propulsion	Solid Fuel Rocket
Seeker	IIR, TV
Weapon Control	Video and command data link
Warhead	341 kg general purpose or 364 kg penetrator (approximate equivalent penetration capability to BLU-109/B)
Aircraft Compatibility	B-52, F-111, F-15, F-4, F-16, Mirage 2000, Kfir and A-4.
Capability	
Standoff Range	Greater than 50 nautical miles
Accuracy	Precision less than 3 meters
Aimpoint Selection	Yes
Day/Night Operation	Yes, IIR day or night, TV day
Trajectory Control	Yes – programmable vertical or horizontal flight profiles and impact angles
Battle Damage Information	Yes – real-time in-flight playback impact up to impact
Target kill hard/soft	Yes – against horizontal and vertical targets at weapons max standoff range
Employment	
Delivery Tactics	Flexible – several vertical and horizontal trajectory options
Aircraft Exposure	Has the longest standoff PGW system currently operational, minimizing aircraft attrition
Degraded weather conditions	Yes –demonstrated capability
Logistics and Training	Exists world-wide


HAVE LITE
Highly Accurate and Lethal

Popeye Turbo



In May 2000 Israel is reported to have secretly carried out its first test launches from two German-built Dolphin-class submarines of cruise missiles capable of carrying nuclear warheads. The missiles

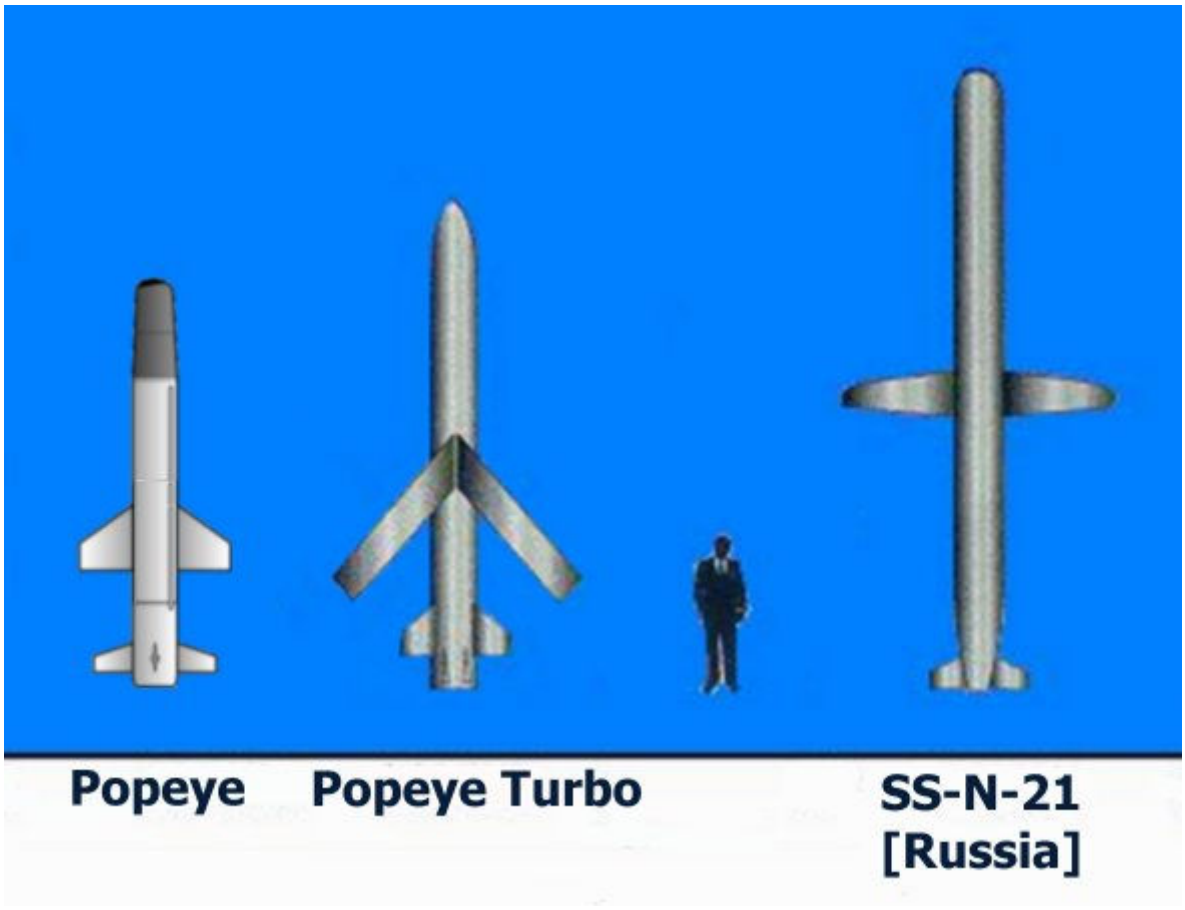
launched from vessels off Sri Lanka in the Indian Ocean are said to have hit a target at a range of about 1,500 kilometers. Israel is reported to possess a 200kg nuclear warhead, containing 6kg of plutonium, that could be mounted on cruise missiles.

Israel has reportedly developed an air-launched cruise missile that could be operational by 2002, called the Popeye Turbo. The Popeye Turbo, with a range that is variously reported at between 200 km and 350 km, would appear to represent a turbo-jet powered cruise missile that may incorporate avionics and other components developed for the Popeye family of missiles. The AGM-142 HAVE NAP is a variant of the Israeli Air Force "Popeye" missile, which uses a solid propellant rocket motor. The Popeye II, also known as the Have Lite, is a smaller missile with more advanced technology. Designed for deployment on fighter aircraft, Popeye II has a range of 150 kilometers.

The Popeye Turbo missile is probably similar to if not identical with the Israeli submarine-launced cruise missile carried on the Dolphin-class submarines. The baseline Popeye missile with a range of 45 miles has a diameter of 21 inches, and is nearly 16 feet long. For comparison, the American MK-48 heavy torpedo is 21 inches in diameter, and 19 feet long, while the BGM-109 Tomahawk SLCM is 20.4 inches in diameter and 20.5 feet long [including the booster motor], and the Russian SS-N-21 SLCM is similar in configuration and dimensions to the American Tomahawk.

The reported range of 1,500 km for the SLCM tested in May 2000 is several times greater than the previously reported range for the Popeye Turbo. However, the Popeye Turbo is a poorly attested missile, and the open literature provides little information on this system. Indeed, because of the small size of the vehicle and the limited testing program to date, it is entirely possible that even the US intelligence community has only limited insight into the capabilities of this system. There is no particular reason to doubt that Israel could develop a variant of the Popeye Turbo with a range of 1,500 km, simply by lengthening the fuel tank associated with a 300-350 km variant reported by US intelligence. At present it is not possible to determine whether the US intelligence has under-estimated the range of this missile, or whether news reports have over-estimated the missile's range. The longer range reported in June 2000 is certainly consistent with Israeli targetting requirements.

It is generally agreed that these submarines are outfitted with six 533-millimeter torpedo tubes suitable for the 21-inch torpedoes that are normally used on most submarines, including those of the United States. Some reports suggest that the submarines have a total of ten torpedo tubes -- six 533-millimeter and four 650-millimeter. Uniquely, the Soviet navy deployed the Type 65 heavy-weight torpedo using a 650-millimeter tube. The four larger 25.5 inch diameter torpedo tubes could be used to launch a long-range nuclear-capable submarine-launched cruise missile (SLCM).



Nimrod

Air and Ground Launched Precision Guided Munition (PGM)

Nimrod is an anti-tank and anti-personnel laser homing missile of 26 km range and pinpoint accuracy. It is easily installed on a variety of ground platforms and helicopters.

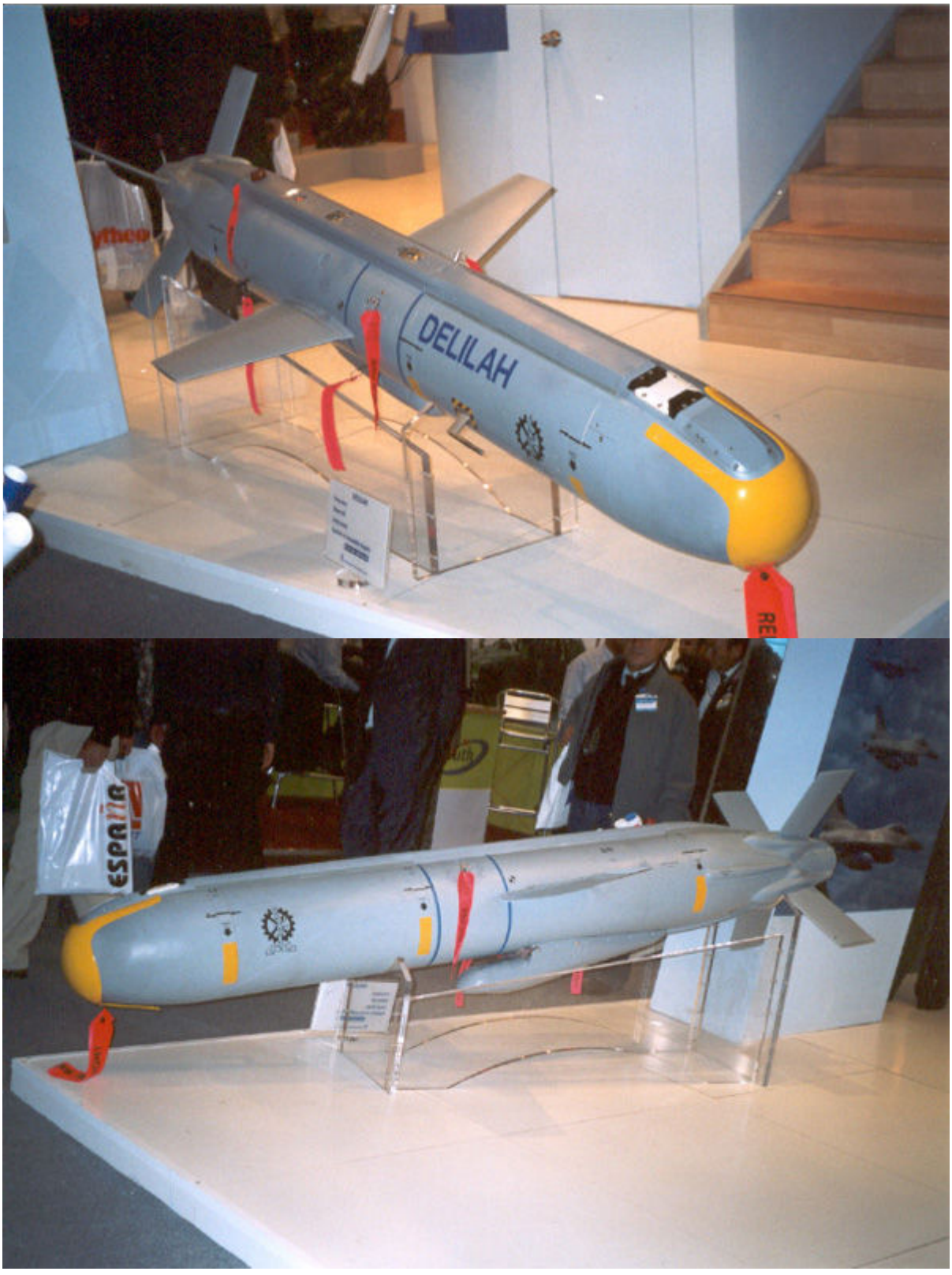
On land, it provides standoff strike capability against ground point targets such as tanks, APCs, bunkers, personnel concentrations and guerrillas. A forward scouting team uses a laser designator to direct missiles that are fired from a base up to 26 km behind.

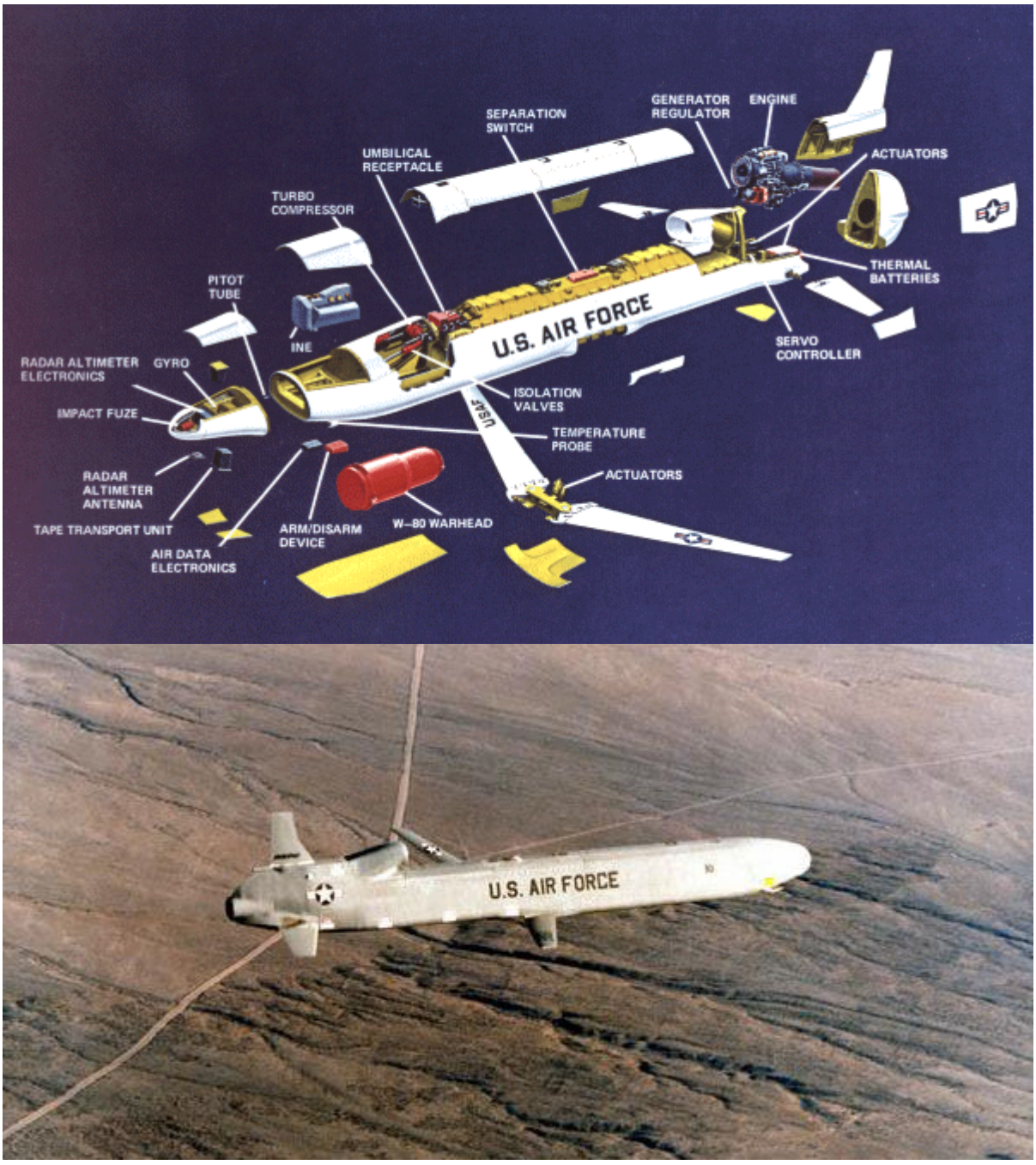
Mounted on light vehicles, the system is inherently mobile, and is a natural candidate for rapid-deployment forces. In mobile or fixed shore installations, Nimrod is an excellent coastal defense weapon.

Nimrod is capable of day/night operation. Its flight trajectory can be set below clouds.

Category	Anti-Armor
Manufacturer	Israel Aircraft Industries
City	Lod, Israel
Length	265 cm
Span	40 cm
Body	18 cm
Weight	100 kg
Guidance	IAI
Guidance Type	Laser-guided
Model	1-stage spr.
Range	26 km
Speed	0.8 Mach
Status	Long range missile in production

Delilah 1





AGM-86 Air-Launched "Cruise" Missile.

IMI is offering its Delilah long-range 400-pound precision strike weapon as a helicopter launched missile. According to IMI officials, Delilah has already tested on helicopters, and can be carried under stub wings like Hellfire and Spike anti-tank missiles. It is being considered for operation on helicopters such as the Sikorsky Black Hawk and Seahawk for land and sea surface attack missions. Unlike cruise missiles, which were designed mainly for long range, Delilah combines long range (250 km) with loitering over the target-an essential and unique capability, required for attack of evasive or concealed high-value targets. The jet-powered missile can navigate autonomously along a pre-planned route, drawing on a combination of inertial and GPS and can be launched from an aircraft, helicopter or ground launcher.

For precision strike, IMI offers the Delilah and MSOV weapons. Unlike cruise missiles, which were designed mainly for long range, Delilah can combine a range of 250 km with loitering over the target-

an essential (and unique) capability for attacking evasive or concealed high-value targets. The jet-powered, 400-lb missile can be launched from an aircraft, helicopter or ground launcher and navigates autonomously along a pre-planned route using a combination of inertial and GPS data. With its compact dimensions Delilah can be carried on helicopters such as the Sikorsky UH-60A and SH-60B. Its small but effective warhead is designed to provide maximum destruction to the target while minimizing collateral damage.

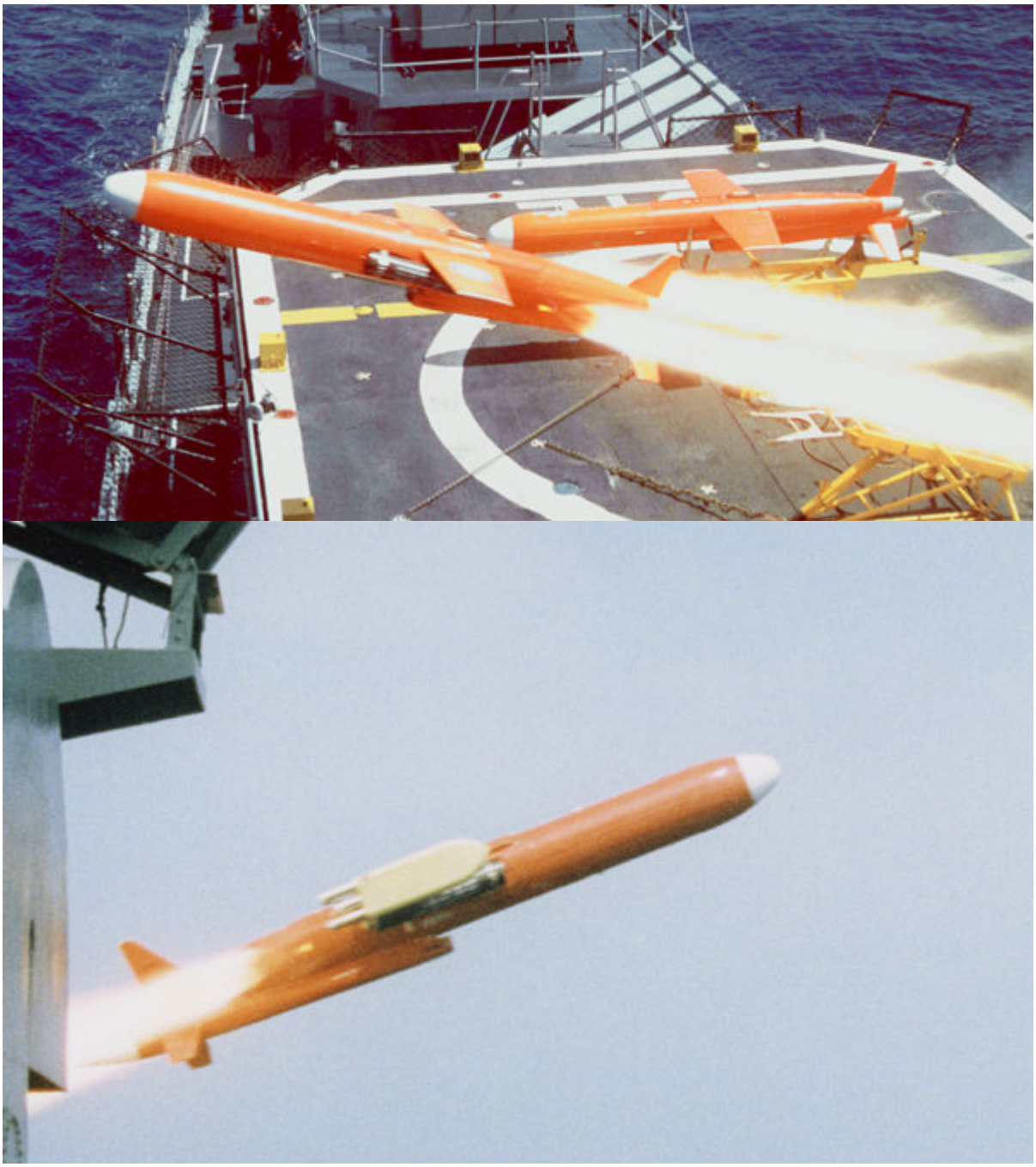
In 1995, Flight International reported that China was providing funding to Israel for development of an air-launched cruise missile based on the Israeli Delilah anti-radiation attack drone. The report noted that China also would be a customer for the new cruise missile. The basic Delilah is a 230-mile range drone which has benefited from U.S. technology in airframe design and in its small U.S.-designed Williams J400-WR-401 engine. This missile has an accuracy of 300 feet.

The new missile (Delilah 2) reportedly will be larger than the Delilah but will retain its basic configuration. It is not clear whether the larger size will allow for both a longer range and a larger payload, or just the latter. This might be provided in the recently revealed Bet Shemesh Sorek 4, which produces 800 pounds of thrust. If and when acquired, this new version of the Delilah would give the PLA a much more useful and accurate cruise missile. It also would provide advanced cruise missile technology in the areas of design, engines, fuel, and guidance.

Main Characteristics:

Range: 400km
Payload: 50kg

Israel Seeks U.S. Technology To Turn Decoy into "Stealth Missile"



MQM-74 Chukar unmanned aerial vehicle (UAV).

A pending request for a military technology transfer of radar-evading paint from a U.S. to an Israeli manufacturer would turn an Israeli pilotless aircraft into a deadly missile that could evade "all radars the U.S. has sold" to the Middle East, according to the U.S. inventor. The quantity of the stealth aircraft coating, called Signaflux, ordered by Israel also raises questions about Israeli intentions.

The coating has been ordered by Israel Military Industries for its pilotless "Delilah," which is capable of delivering a 1,000-lb. warhead to targets within 240 miles of the point of launch, according to Aviation Week & Space Technology.

The original Delilah, first fielded in the late 1980s, was a cheap, ground-launched decoy aircraft whose sole mission was to attract anti-aircraft fire and, thus, enable aircraft or other missiles to fly to their targets in relative safety.

Today's upgraded version of the Delilah has an offensive capability. Resembling a U.S. Air Force AGM-86 Air-Launched "Cruise" Missile in both configuration and capability, the ramjet-powered Delilah measures nine feet long, travels at nearly the speed of sound and can be launched from the ground, aircraft or ships.

The Israeli manufacturer of Delilah is hoping to give it the ability to fly undetected to its targets by painting the unmanned aircraft with Signaflux. This, said one Air Force colonel, "would make the Delilah a sort of poor man's stealth missile."

Washington Report's Pentagon source, and David A. Fulghum, a military technology correspondent at Aviation Week, also revealed that the Israeli Delilah is a copy of the American-made Northrop MQM-74 Chukar unmanned aerial vehicle (UAV).

The Chukar is an aerial target which the U.S. Navy has used since the early 1960s to simulate subsonic threats. Northrop has shipped over 1,000 Chukars to overseas clients.

Northrop spokesman Loye Miller acknowledges that Israel took delivery of several of his company's Chukar UAVs in the late 1970s. Miller said that Northrop does not officially consider the Delilah to be a re-engineered version of the Chukar, and that what the Israelis do with the Delilah "is of no concern to Northrop."

Signaflux inventor David Keen told the Washington Report that his company, Signature Products of Huntsville, AL, has arranged shipment of the secret paint to Israel. The technology transfer still is awaiting approval, however, from the Departments of State, Commerce and Defense.

Keen says the optically transparent Signaflux is a blend of polyaniline, a high molecular-weight polymer, and carbon-based filaments called "cyanate whiskers." The cyanate whiskers are the "key to getting good radar absorption. "

"Cyanate whiskers are comprised of microscopically thin strands of carbon-60 fiber whose electrical conductivity has been modified by a series of acid washes in a strong, electrically polarized field, says Keen.

"When Signaflux is suspended in polyurethane or some other polymer, it can be sprayed, applied or laminated onto an aircraft's surface-even on a cockpit window, " says Keen. "In flight, the cyanate whiskers break up incoming radar signals and absorb them."

"Put simply," said Keen, "when Signaflux is combined with metal, it makes the metal appear to be a non-metal.

Keen says his coating can be mixed with most traditional and non-traditional aircraft paints, including the DuPont-manufactured Viton paint used on such supersonic American-made fighter planes as the F- 15 "Eagle" and the F-16 "Fighting Falcon. "

Keen speculates that approval of the Signaflux sale to IMI is being held up because U.S. government officials are worried that "once the secrets of the radarevading paint are exported to the Mideast, it will nullify all radars the U.S - has sold to other countries in the area."

The U.S. inventor says that IMI's order forSignaflux paint is unusually large. Keen says his business arrangement with Israel prevents him from revealing the details, but "they want far more paint than they'll ever need for their Delilah missiles. "

Keen says, however, that the Israeli engineers who negotiated the purchase "were very specific about the wavelength of the radio signals the paint had to absorb, the kinds of mil spec [U.S. military specification] coatings it had to be blended with, and so on ... It's a whole lot of paint. I can tell you that much."

Keen says that during business meetings with IMI representatives, he was told that the stealth version of Delilah was to be targeted against Tripoli, Libya.

"They also said Delilah had to be able to circle over the Tripoli area for at least one hour," Keen adds.

Keen says he learned of Israeli intentions for the stealth UAV during a meeting at IMI's ultra-secure offices in Bethesda ' MD. He says his main point of contact at IMI is Yoval Sharony, the company's director of marketing.

Keen describeshimself as an honest American businessman who seeks to export a product that could enhance the military capability of a country he considers a strong U.S. ally. He says he understands the need for the U.S. government to impose controls on the export of militarily sensitive technologies, but expresses frustration with the time-consuming bureaucratic process associated with obtaining an export license.

Keen says Signature Products is using legitimate means to export Signaflux to Israel. The inventor adds, however, that if he had wanted to bypass U. S. export regulations, he could have misrepresented the radar-absorbing characteristics of Signaflux on his export application.

"If I were a dishonest businessman," says Keen, "I could have told customs I was shipping an 'erosion deterring coating,' and the Israelis could have had their Signaflux a long time ago."

Dennis Benjamin, manager of the Outbound Enforcement Program at the U.S. Customs Service, acknowledges that if a shipper misrepresents the characteristics of a technology in an export license, it is possible for an unapproved shipment of radar-absorbing paint to slip past his inspection and control officers.

"But just because somebody thinks up a cute name for something on the State Department's Munitions Control List doesn't mean they won't go to jail for violating the Arms Export Control Act," Benjamin cautions.

He said maximum criminal penalties for illegally attempting to export military related materials can include a 10-year jail sentence, a $1 million fine, or both When the Washington Report first contacted Yoval Sharony at IMI's Bethesda office to confirm the facts in this story, Sharony insisted, "The story in Aviation Week is totally false. It's about some other UAV, not ours."

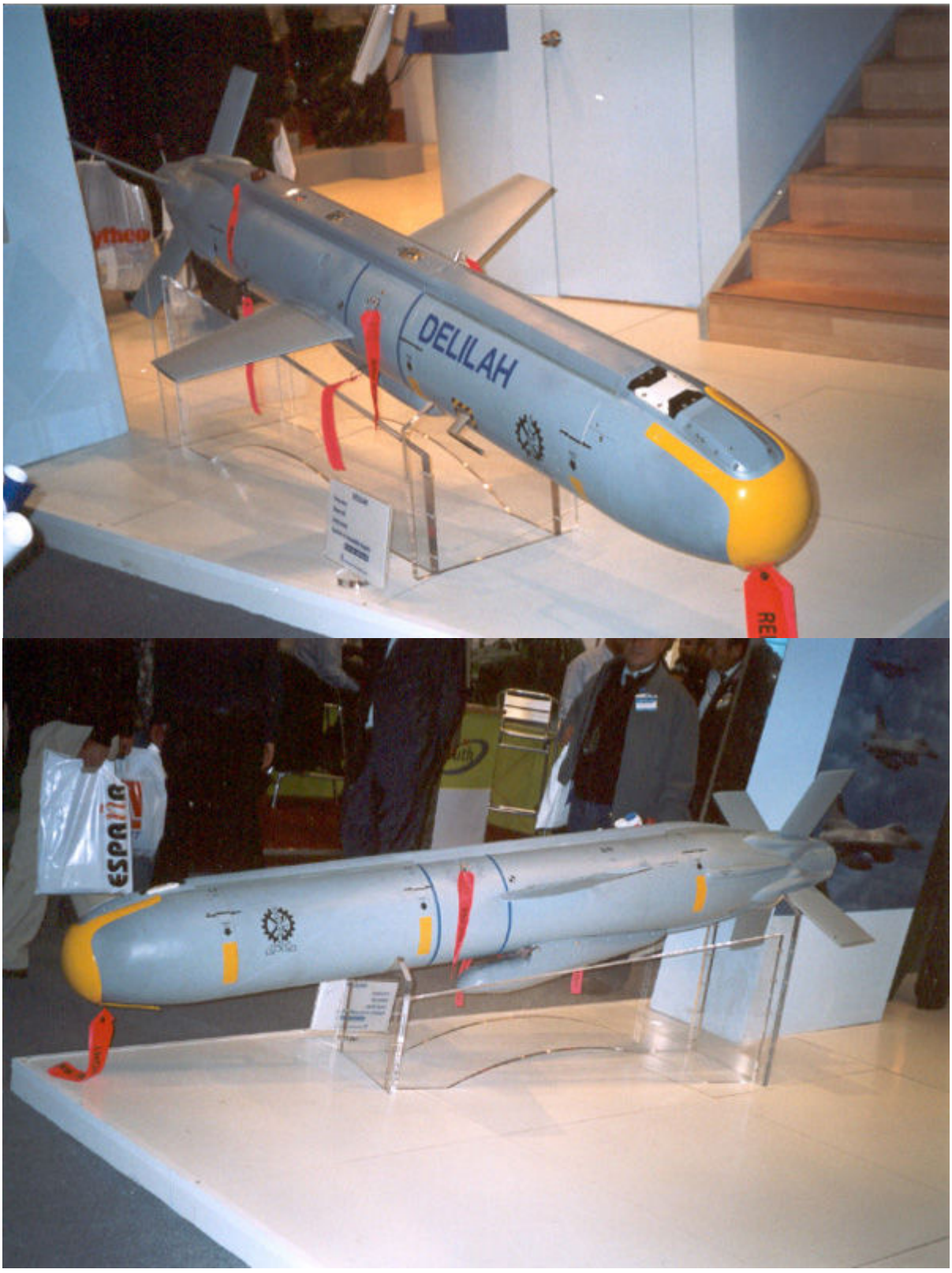
During this first telephone interview Sharony also said that his activities for IMI are limited to "marketing at trade shows like AUSA [an annual exhibition of military equipment sponsored by the Association of the United States Army], and trying to interest the [U.S.] Navy and AirForce in buying the Delilah. " Sharony said he does "not do acquisition business for the company."

During the Washington Report's firstconversation with Sharony, the IMI official denied ever having met David Keen, and said that Keen has never visited IMI's offices in suburban Maryland.

In a second interview, Sharony acknowledged that IMI had some dealing with Keen, but said "I was possibly out of the country" when Keen met with IMI officials in Bethesda. During this second telephone conversation, Sharony dismissed as ridiculous" Keen's claim that he had been told by IMI officials that Delilah would be targeted against Libya.

During a third conversation, Sharony admitted he had been introduced to Keen, but said he had "only one" encounter with Keen while visiting the corporate headquarters of Signature Products in Huntsville. Contradicting his claim that he served "only as IMI's marketing director," Sharony said the reason for his meeting with Keen in Alabama was -to see if Signaflux was something we'd be interested in."

Delilah 2

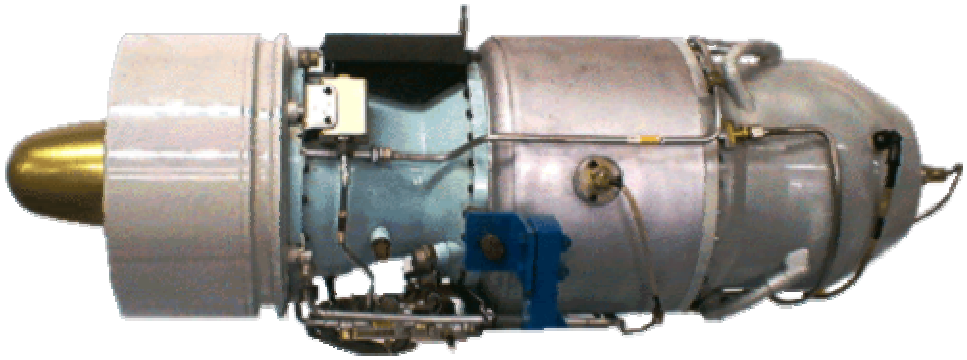


Delilah 1.

Israel is developing a strike UAV named the Light Defender, and this UAV will be used to search and destroy surface-to-air missile systems. This suppression of enemy air defense (SEAD) capability will most certainly have an effect on the future of the manned EA-6Bs and the F-16CJs, the United State's current SEAD assets. Currently, the Services have no plans to develop a next generation of manned SEAD aircraft. Perhaps, the fielding of the Light Defender might lead to an early retirement of current SEAD aircraft. As the Light Defender program illustrates, the US is not the only country pursuing UAV development, countries such as Israel, the United Kingdom, Germany, and Finland are forging ahead into other payload areas. For example, Germany's Taifun antiradar drone is being developed to target radars and ground vehicles. The development of technologies for other UAV roles and missions might begin overseas, but the United States will undoubtedly seek to regain the lead in these emerging technologies. As in the case of Israel's Light Defender Program, the United States Air Force is studying this concept under the Foreign Comparative Test Program.

In 1995, Flight International reported that China was providing funding to Israel for development of an air-launched cruise missile based on the Israeli Delilah 1 anti-radiation attack drone. The report noted that China also would be a customer for the new cruise missile. The basic Delilah is a 230-mile range drone which has benefited from U.S. technology in airframe design and in its small U.S.-designed Williams J400-WR-401 engine. This missile has an accuracy of 300 feet. The new missile reportedly will be larger than the Delilah but will retain its basic configuration. It is not clear whether the larger size will allow for both a longer range and a larger payload, or just the latter. This might be provided in the recently revealed Bet Shemesh Sorek 4, which produces 800 pounds of thrust. If and when acquired, this new version of the Delilah would give the PLA a much more useful and accurate cruise missile. It also would provide advanced cruise missile technology in the areas of design, engines, fuel, and guidance.

SOREK 4



SOREK 4 engine is a low diameter simple turbojet engine. The engine is a single shaft and has one axial and one centrifugal compressor stage driven by a single turbine.

The engine can be started by windmilling or by special pyrotechnic starter, ignition is pyrotechnic. The engine features a full authority digital electronic control (FADEC). A 1.5 Kw alternator is integral in the engine.

Performance:

Rated SLS Thrust: 810 Lb (367 Kg)
SFC SLS (Lb/Lbf/hr): 1.225 Lb/Hr
Airflow: 12.3 Lb/sec (5.6 Kg/sec)
Altitude: 33,000 ft (11 Km)

Flight speed: Mach 0.9
Dimensions:
Dry Weight: 159 Lb (72 Kg)
Length: 42.6" (1082 mm)
Max. Diameter: 13" (330 mm)

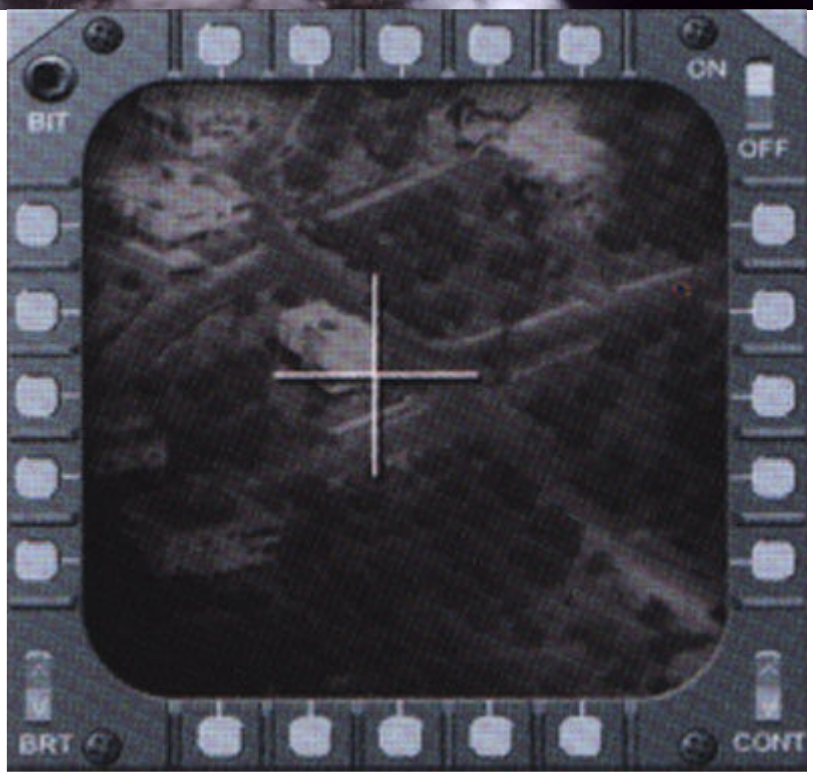
Spice
Stand-Off Precision Guidance Munition (PGM) Kit

SPICE
affordable force multiplier

A modern kit derivative of the operationally successful Popeye (Popeye, Popeye Lite) missile family, SPICE can upgrade existing ordnance into precision guided Air-to-Surface weapons. SPICE is a fully autonomous Precision Guidance Munition (PGM) bomb which for the first time incorporates autonomous Electro-Optical guidance with satellite guidance. This astonishing ability could not be achieved if not by an Electro-Optical breakthrough carried by Israel's Armament and Development Authority (RAFAEL). The bomb's uniqe advantage over regular stand-off bombs is its ability to utilize Scene Matching by preloading several target images, and then comparing the targets to a real-time Electro-Optical image which is acquired by the bomb's Electro-Optical seeker. Thus, the bomb can locate the target autonomously, prepare its flight course and hit it with absolute precision.

SPICE surpasses the GPS-guided bombs that starred in the recent war in Iraq , since the Target Acquisition System is not dependent solely on its Imaging capability, but has a backup- the system deploys GPS guidance, in case the Electro-Optical sensor cannot acquire the target for some reason. In such case, the SPICE has the accuracy of a regular JDAM-type GPS-guided weapon.

The bomb flies at 0.9 Mach, at all weathers conditions, scans the sighted area, and constantly compares it to its preloaded targets bank. Once an image of the targets bank matches the real-time acquired image, the seeker will guide the bomb into the specified target with striking accuracy.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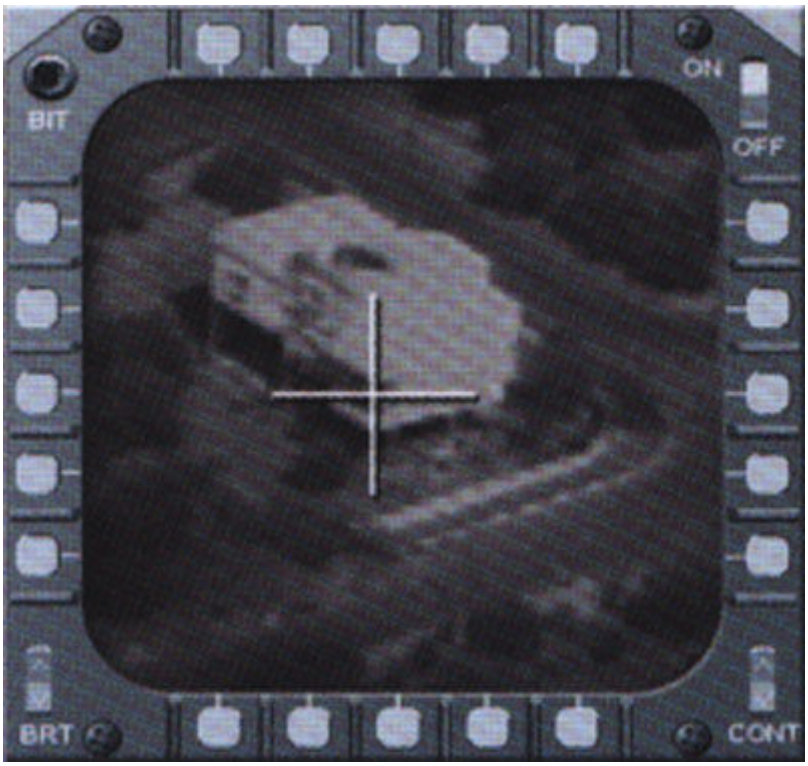


SPICE has an effective drop range of 60 km, which allows the attacking aircraft to destroy the target without getting into the threat zone. Any aircraft can carry several bombs, and select the targets at the course of flight. Since it is not dependent on coordinates fed to it by a satellite, the Israeli-made PGM cannot be jammed. Nor can it be "spoofed" that is, given false coordinates by the enemy who then sends a very expensive bomb into a strategically valueless meadow . The bomb significantly improves pilots preparation and studying of targets, thus shortens time preparation intervals between flights. After the targets are loaded into the bomb's computer, and the bomb is dropped, it homes, navigates and guides itself without pilot's intervention. It has all the characteristics of a Fire-and-Forget munition, without the high costs of a missile.

RAFAEL has started production of its SPICE stand-off precision guidance kit and is adapting the system for smaller bombs than the initial weapon's 900kg Mk84 bomb, such as the 450kg Mk83 bomb.

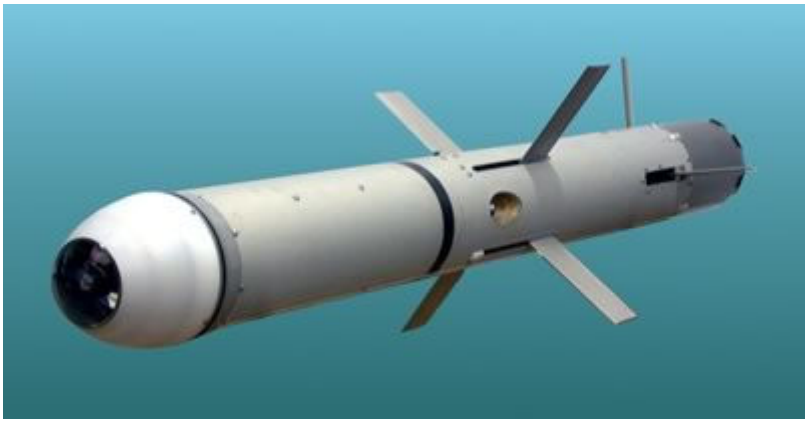
Another source relates to the fact that the kit has also been cleared for the BLU-109 penetrator warhead.

The forward element, which contains the Electro-Optical seeker and a combined inertial/GPS satellite navigation system will be unchanged. The rear element – comprising wings, moveable tail surfaces to steer the weapon and the power supply – will be modified to match the Mk83's smaller diameter. A senior programme official says all systems will be unaltered, as the existing line-replaceable units will fit the new profile. One official adds that RAFAEL is considering Spice technology with lighter warheads, creating a system similar to the US small diameter bomb programme. Sources at RAFAEL at Haifa, northern Israel, also say initial production for the Israeli air force has started following the conclusion of tests. RAFAEL does admit that the Spice is more expensive than other PGMs. But then again, an American-made Tomahawk cruise missile costs $ 1 million.

Range	60 km
Speed	0.9 Mach
Guidance type	Electro-Optical, GPS
Weigh	Mk84 - 900Kg Mk83 - 450Kg

NTD (SPIKE-ER)

Fire and Forget or Fire, Observe and Update multi purpose weapon system



SPIKE-ER (NTD)

WEAPON SYSTEM

AN ADVANCED MULTI-PURPOSE MISSILE SYSTEM FOR COMBAT VEHICLES AND GROUND FORCES

The SPIKE-ER is a stand-alone anti-armor weapon system forcombat vehicles/tripods. It is almost identical to the SPIKE-LR Weapon System.

This compact system includes:

- A SPIKE-ER Missile
- A CLU & Thermal Sight
- A SPIKE-ER Launcher

SPIKE-ER MISSILE

The SPIKE-ER Missile is a highly lethal, Fire & Forget and Fire, Observe & Update anti-armor weapon with the ability to defeat a variety of targets at extended ranges of up to 8000m, day or night and in adverse weather conditions. Its tandem warhead and lofted flight trajectory enable the SPIKE-ER to achieve an extremely high kill probability. The combination of an electro-optic seeker (CCD or Dual CCD/IIR) and a fiber-optic data link provides the unique ability to:

- Switch targets or abort missile after launch
- Attack concealed targets
- Perform real-time surveillance and damage assessment
- Achieve extended range and pinpoint accuracy
- Minimize collateral damage

SPIKE-ER MISSILE

Fire & Forget / Fire, Observe & Update/ Fire & Steer	
Fiber-optic Bi-directional Data Link	
Electro-optic CCD or Dual CCD/IIR Seekers	
Tandem Warhead	
Range:	up to 8000m
Length in Canister:	1670mm
Outer Diameter:	170mm
Weight in Canister:	33kg

CLU / THERMAL SIGHT

COMMAND LAUNCH UNIT (CLU)

Weight: 5kg

THERMAL SIGHT (TS)

Two Fields of View

Focal Plane Array

Weight: 4kg

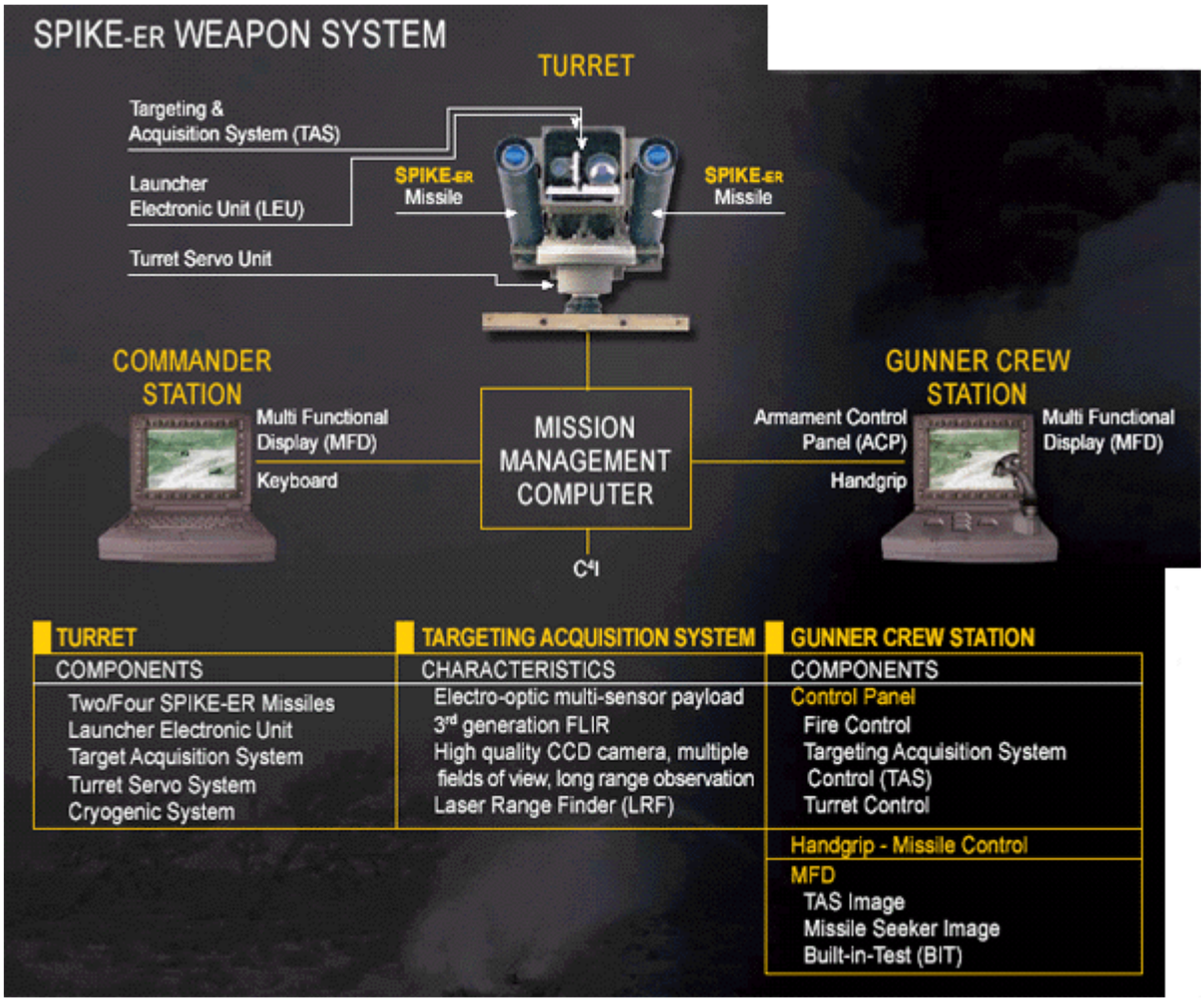
SPIKE-ER LAUNCHER

Provides interfaces to the missile, CLU and TS

Can be easily mounted on various platforms

An internal pan and tilt system allows two Degrees of Freedom

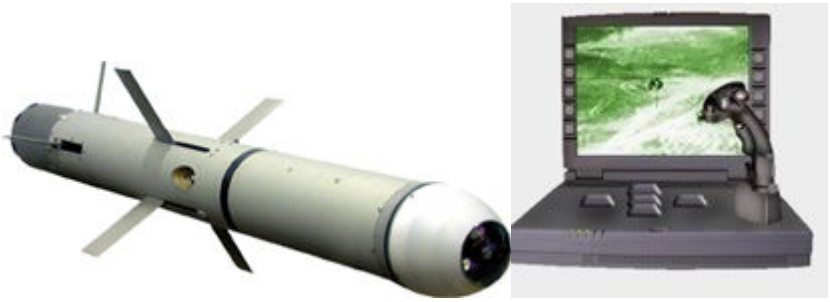
Weight: 15kg



The SPIKE-ER (formerly designated NTD) is a multi-platform, lightweight missile system for ranges of up to 8,000. It shares all the benefits of the man-portable Spike and Gill system, however, was designed to be mounted on combat vehicles, helicopters and naval vessels.

NTD with the unique ability to:

Update or switch targets after launch
Achieve real-time intelligence and identify friends or foe
Perform battle damage assessment
Achieve extended range and pinpoint accuracy
Minimize collateral damage



Effective range	400 - 8,000 meters
Length: (Missile in canister)	167 cm
Diameter (Missile in canister)	17 cm
Weight	
Missile in canister	33 kg
Launcher	55 kg
Launcher + 4 missiles	187 kg
Tripod	3 kg
Operation	Fire and Forget Fire, Observe & Update Fire and steer
Propulsion	2 stage solid rocket motor
Guidance	Electro Optical (CCD, IR or Dual CCD/IIR), Passive CCD or dual CCD/IIR seeker.

For Vehicles

SPIKE-ER (NTD) For Light Combat Vehicles
The SPIKE-ER is a stand-alone anti-armour weapon system that is designed for mounting on combat vehicles. It can also be dismounted to a ground position, fitted onto a tripod. The compact system includes the SPIKE-ER missile packed in its canister, the Command Launch Unit (CLU), a thermal sight and the SPIKE-ER launcher.

SPIKE-ER (NTD) Weapon Package For Light Combat Vehicles
This mounted, remote controlled SPIKE-ER Anti-Armour Weapon System provides a complete armament package for Light Combat Vehicles (LCV). The system is modular and can be easily adapted to a variety of platforms. The package includes the SPIKE-ER or SPIKE-LR missile in its canister, a remotely controlled turret, housing a target acquisition system, launcher electronics unit and servo unit, and a gunner crew station accommodating the armament control panel, multi-functional display and handgrip.

For Helicopters

In the Fire and Forget mode and the Fire, Observe and Update mode the SPIKE-ER's seeker dictates lock-on before launch. In the Fire and Steer mode, there is no need to lock-on target before launch; the pilot has the ability to choose the target after launch and steer the missile to the most vulnerable part of the target or lock-on and proceed with the Fire and Forget. In both, the Fire, Observe and Update, and and Fire and Steer modes, a bi-directional fiber-optic communication link transmits target images back to the launch platform enabling the pilot to update aim point or change targets mid-flight. The link also enables precision maneuvers within urban areas, mask down capability and real-time surveillance. the SPIKE-ER can be installed in the AH-1S Cobra, Agusta A-129, MD-500 Defenders, Gazelle, Mi-24 Hind and many more.

The SPIKE-ER helicopter-launcher, equipped with full helicopter interface, hosts up to four missiles within their canisters. It implements all aspects of missile operation including missile selection and activation, down and uplinks and firing sequence. The launcher is connected to the fixed helicopter pylon via 14" standard lugs on each side on each side of the helicopter and requires no helicopter modifications, other than software integration.

The launcher provides the following functions:

Hosts up to four rounds
Supports operational and training missiles
Provides an electrical interface via 1553 Mux-Bus between the rounds and the helicopter
Provides gas coolant to IIR missile seekers
Allows rapid round loading and unloading
Provides full electronics, power supply and mechanical interface, allowing easy customization for any modern combat helicopter

HeliCOAT Combat Helicopter Upgrading Suite

The RAFAEL SPIKE ER (NTD) long range anti-tank missile is an integral to the HeliCOAT advanced weapon package for the modernization and upgrading of helicopters. HeliCOAT enables any helicopter to carry out an attack mission, day or night and in adverse weather conditions. HeliCOAT enables the engagement of multiple targets, hard or soft, at long and stand-off range with pinpoint

accuracy and maximum helicopter and crew survivability.

The HeliCOAT system includes:

Spike ER missiles and launcher
TOPLITE Observation System
Self-Protection & EW System
Helmet Mounted Sight (HMS)/Night Flight Capability
Modified Cockpit
- Navigation Moving Map
- MFCD
- Pilot's Monitor
- Right and Left Handgrips

MSOV

MSOV is a 2300 lbs. standoff air-launched glider dispenser, aimed at area targets such as airfields, SAM sites, dispersed equipment and personnel and maritime installations. With its 1490 lbs. modular-dispensing warhead, MSOV can deploy a variety of submunitions including anti-tank mines, dual-purpose bomblets, anti-runway penetrators etc.

A GPS/INS navigation system along with a state of the art avionics enables an on-the-ground or in-flight programming for autonomous gliding profile, and optimal direction of approach towards the target.

Based on its unique design, folding wings, and 30-in. suspension lugs, MSOV is compatible with fighter aircraft such as F-16, F-4, F-15 and others.

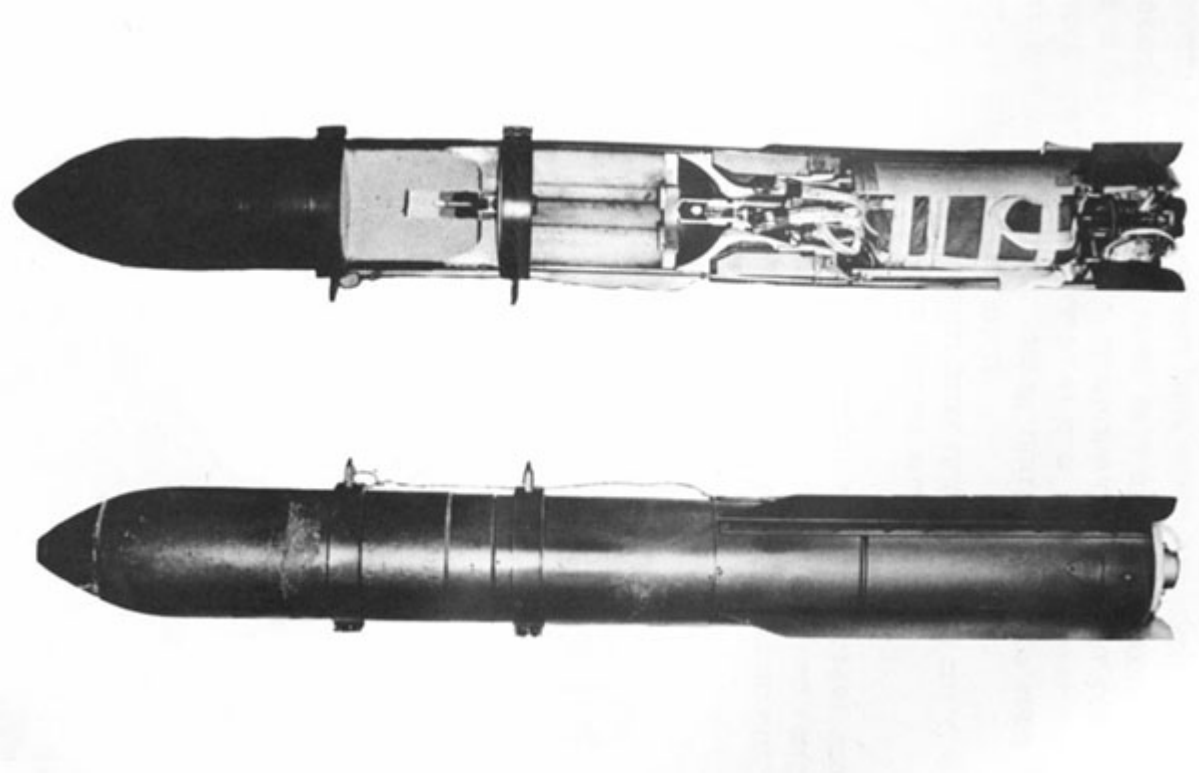
The development of MSOV is based on the updated operational needs of air-to-surface missions, along with the state of the art experience of IMI in the aerial standoff weapon systems.

In April '98 IMI concluded the initial development stage with a first demo flight test on an Israel Air Force F-16, including safe separation and wing deployment.

Main Characteristics:

Total weight: 1050 Kg
Payload/Warhead: 675 kg/ 0.36 m3
Length: 3.97 m
Max Range: 100 Km

Anti-Runway Bomb

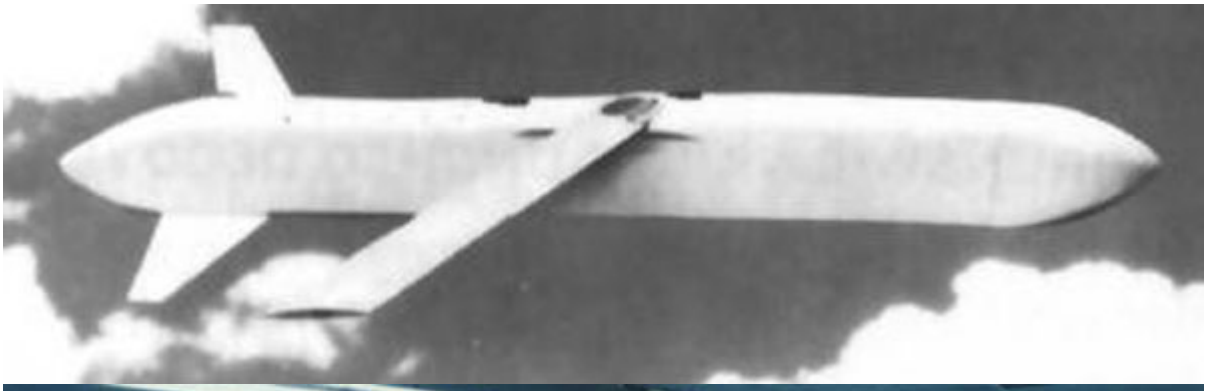


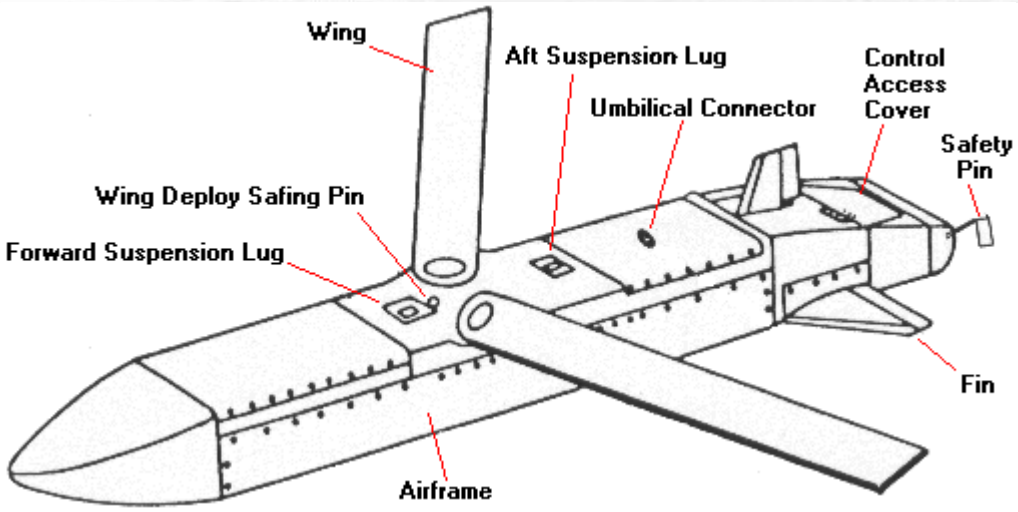
In the mid 60s, the central laboratory headed by Avraham Makov, was focusing on the development and manufacture of a bomb whose purpose would be to disrupt enemy airfields runways. The anti-runway bomb is assembled under a fighter's wing, as any regular bomb, and released at 100m flight altitude. Few seconds later, a parachute opens, breaking its descent, steering it at a 60 degree angle, with its nose pointed towards the ground. At that precise moment, a rocket attached to it, propels the bomb's warhead into its target (the runway), penetrating and piercing through its concrete layer. After a 6 second delay, the warhead is detonated, creating a 5 m wide by 1.6 m deep hole in the runway, preventing its operational status.

The anti-runway bomb received high profile media coverage at the end of the Six Day War (1967), mainly due to its important role in achieving air-superiority by the Israeli air force at the start, and in the early stages of the war. The development of that bomb was completed a few months before the Six Day War (1967). During 1966, 187 bombs of the smaller type and 66 of the larger type were delivered. The Israeli air force had an inventory of approximately 200 anti-runway bombs as the war started, and made a lightening and very effective use of them.

Weight: 70 kg.
Warhead weight: 43.5 kg
Length and Diameter: 1.58 x 0.18 respectively

TALD





TALD is an air launched glide decoy equipped with wide band radar passive and active repeaters. When deployed, TALD is aimed to stimulate enemy anti aircraft sites for AR suppression, diversion or saturation of their radar screens.

TALD can be multi-carried on standard ejection racks and launched form most modern fighting aircraft with no modifications to the aircraft avionics. It can glide along a variety of preprogrammed mission

maneuvers and can be launched in multiple flight patterns, at high and low altitudes, including toss mode.

TALD requires no maintenance and can be programmed shortly, just before flight.

During the Gulf War and the conflict in Bosnia, TALDs were successfully deployed with impressive results. Enemy anti-aircraft capability was halted and lives were saved while allied aircraft safely gained air superiority.

TALD can be configured as an aerial target for S/A and A/A missile training; it is currently used by the US Navy and the Israeli Air Force (IAF).

Main Characteristics:

Weight: 182 Kg
Length: 2.34 m
Win Span (unfolded): 1.55 m
Launch Speed: Up to Mach 95
Launch Altitude: Up to 40,000 ft
Range: Up to 67 NM (124 km)
RF Payload: Active/Passive

History

Samson.

By this time, Brunswick Defense Corporation of Costa Mesa, California, was well into development of a series of less sophisticated decoys that would see much more operational use.

Brunswick had worked on decoy concepts through the 1960s, leading to a USAF contract in 1968 for a technology demonstration. The result was the "Maxi-Decoy" series, which were also intended to support radar jamming, chaff-flare dispensing, and ELINT missions.

The first of the series was the "Model 150", first flown in 1973, which was an unpowered glide decoy with pop-out "switchblade" wings. It weighed only 59 kilograms (130 pounds), and two could be carried on a single underwing stores pylon. The Model 150 led to the scaled-up "Model 300", which was similar but weighed 180 kg, giving it much greater payload capacity. Speed and range of these gliders was of course dependent on the speed, altitude, and launch angle of the launch aircraft, but was nominally up to about 750 kph and 140 km.

The third in the Maxi-Decoy series was the "Model 290P". The "P" apparently stood for "powered", since the Model 290P had a solid rocket motor that could burn for up to 300 seconds. It was otherwise

similar in configuration to its predecessors, and weighed 136 kg. The USAF did not order production of the Maxi-Decoys, but Brunswick sold an unpowered decoy named "Samson" to the Israelis. Apparently the Samson was a variant of the Model 300 Maxi-Decoy.

The Israelis had lost far too many aircraft to Arab air defenses during the Yom Kippur War (1973), and decided to invest in decoys as a countermeasure in future conflicts. The Samson decoys were part of the suite of countermeasures the Israelis used over the Bekaa Valley in War in Lebanon in (1982) against Syrian air defenses with dramatic effect.

The US Navy suffered at the hands of Syrian air defenses during America's intervention in Lebanon in 1983, and so Navy officials decided to follow the Israelis' example. In 1985, the Navy awarded Brunswick a contract to provide 1,000 "ADM-141A Tactical Air Launched Decoys (TALD)".

TALD is an improved version of the Samson. TALD weighs from 180 to 204 kg, depending on payload, and up to six can be carried on a single stores pylon, using a pair of triple ejector racks. It has a glide ratio of better than 10:1, and can achieve ranges of over 100 km when released at altitude.

The Navy bought two versions of TALD: the "RF-TALD", which uses radar enhancement devices to provide radar signatures of different types of attack aircraft or a Tomahawk cruise missile, and the "Chaff-TALD", which carries 36 kg of chaff.

Brunswick supplied the original batch of 1,000 TALDs, but later batches were built by an arrangement between Brunswick and Israeli Military Industries (IMI), and in 1987 McDonnell-Douglas became a second-source manufacturer. A total of about 4,000 TALDs were produced into the early 1990s.

The majority of TALDs was produced in license by IMI, and by 1993 more than 4000 unpowered TALDs had been built for the U.S. Navy. The decoy was used very successfully in the opening stages of Operation Desert Storm (1991), when more than 100 were launched to confuse and dilute Iraqi air defense systems.

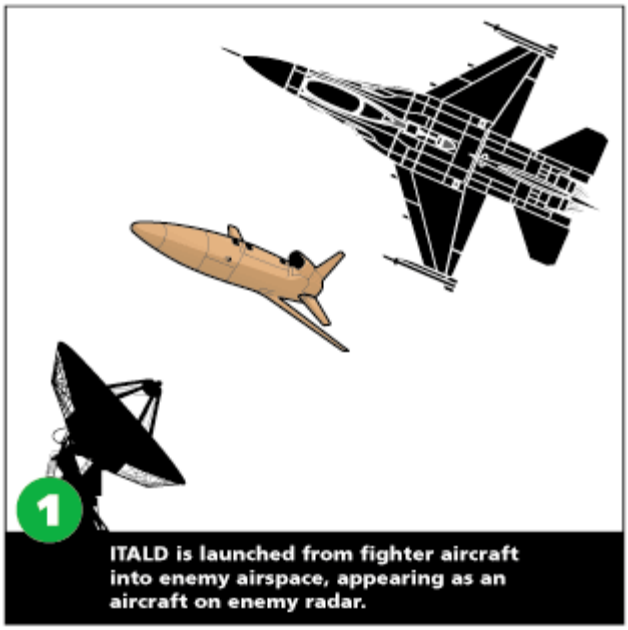
The ITALD is similar to TALD (improved TALD), but is fitted with a Teledyne CAE-312 turbofan, which provides 0.78 kN (80 kg / 177 lb) thrust and was developed for a cancelled anti-radar cruise missile named "Tacit Rainbow". ITALD has a ventral intake for the turbofan, and a radar altimeter so it can maintain low-level flight at a specified altitude over the ground.

ITALD has a speed of Mach 0.8 and range of 280 km at altitude. It can be launched from the ground using a RATO booster, as well as air launched. First flights were in 1995, with trials completed in 1996. At that time, Brunswick got out of the defense business, but the project was picked up by IMI

ITALD

Standoff Tactical Air Launched Turbojet-Powered Decoys

ITALD



1

ITALD is launched from fighter aircraft into enemy airspace, appearing as an aircraft on enemy radar.

2

Enemy fires air defense missiles at decoy, deploying their anti-aircraft arsenal.

ITALD is a powered version of TALD, designed to achieve longer operational range (160 NM) and better maneuverability for more realistic flight profile. ITALD has the same size and weight of TALD, and is equipped with a small turbo-jet engine, enhanced avionics and terrain-following capability. It fitted with a Teledyne CAE-312 turbofan, which provides 0.78 kN (80 kg/177 lb) thrust and was developed for a cancelled anti-radar cruise missile named "Tacit Rainbow". ITALD has a ventral intake for the turbofan, and a radar altimeter so it can maintain low-level flight at a specified altitude over the ground.

The ITALD is an air launched, preprogrammed, powered RF active vehicle used to deceive and saturate enemy integrated air defenses during strike aircraft operations. It is a Preplaned Product Improvement towhead that adds turbojet propulsion and low-level navigation capability to the TALD.. All four versions are compatible with and can be launched from the A/A37B-6E Multiple Ejector Rack (MER), A/A37B-5E Triple Ejector Rack (TER) or a BRU-42 Improved Triple Ejector Rack (ITER).

All versions are approximately 92 inches long with a nominal 10 inches include width and height. The chaff vehicle weighs approximately 172 kg, while all RF passive and active versions weight approximately 181 kg. A computer within each vehicle is preprogrammed with flight profile data prior to loading. It provides flight management and controls of the vehicle through a series of planned maneuvers after launch. The ITALD has enhanced terrain tracking capability and an extended flight envelope for expanded missions.

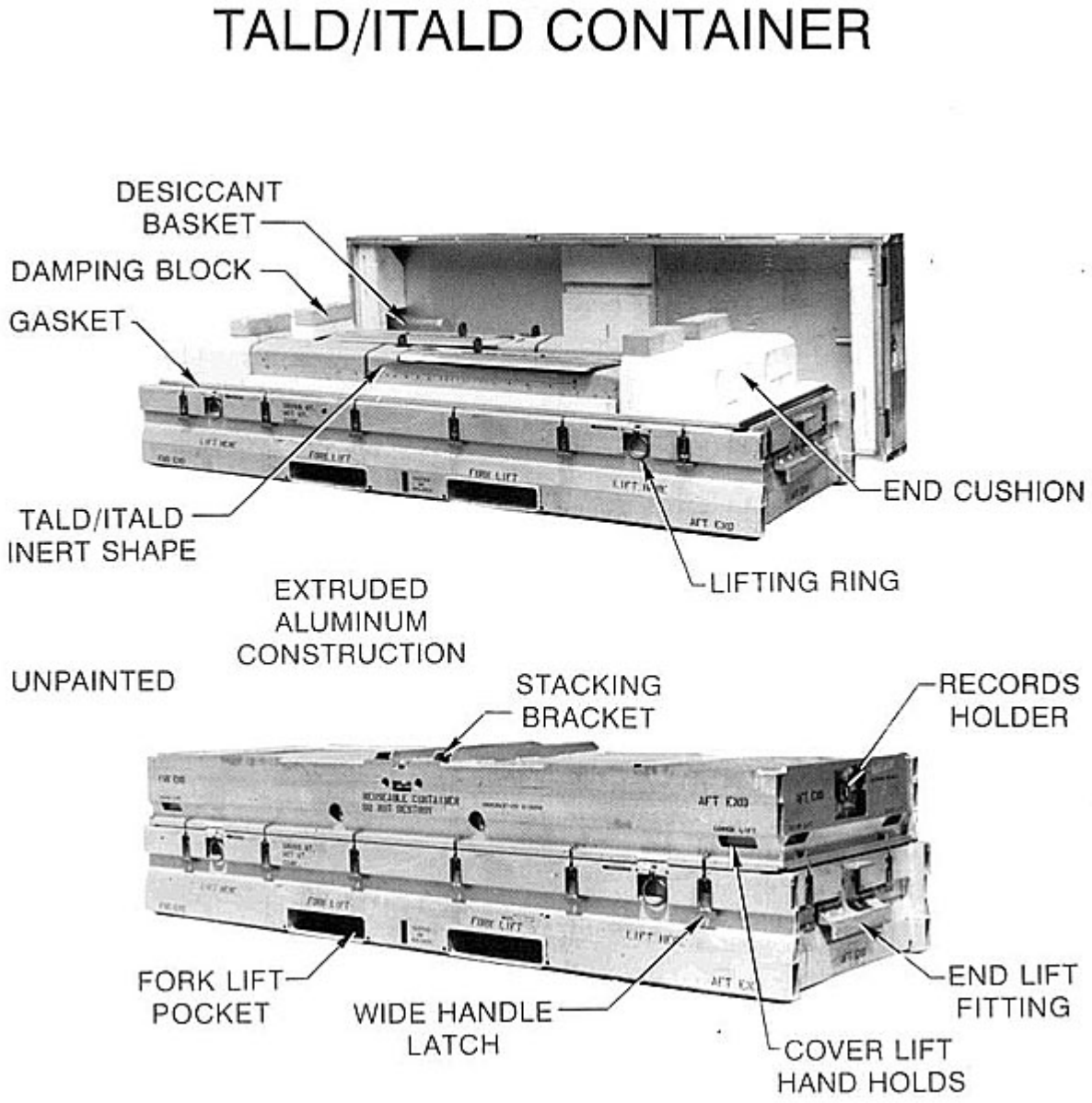
ITALD has a speed of Mach 0.8 and range of 280 kilometers (175 miles) at altitude. It can be launched from the ground using a RATO booster, as well as air launched. First flights were in 1995, with trials completed in 1996. At that time, Brunswick got out of the defense business, but the project was picked up by IMI. The US Navy is now asking IMI to add a Global Positioning System / Inertial Navigation System (GPS-INS) autopilot to ITALD.

ITALD performs all missions autonomously, aided by a GPS and navigation sensors. It can be launched from most fighters without any modification to the aircraft's on-board avionics. ITALD glides along a variety of preprogrammed mission maneuvers. As no maintenance is required, it can be programmed shortly before flight. With a 160 NM operational range, ITALD offers numerous features and advantages: excellent maneuverability, flexible and realistic flight profiles - including a programmable speed of
MO.45 - MO.8, variable altitude of 500 - 30,000 ft, multiple way-point trajectory, launch and forget concept, multiple carriage on standard bomb racks, and a terrain-following capability.

The Improved Tactical Airlaunch Decoy (ITALD) simulates a fighter/attack size aircraft better than

current decoys. The present TALD is becoming less capable even when encountering existing threat integrated air defense systems (IADS).

IMI Wins Additional US Navy Contract to Provide Advanced ITALD



January 26,2003

Israel Military Industries (IMI) has received a US Navy contract for the supply of an additional 140 advanced ITALD (Improved Tactical Air Launched Decoys). IMI is the sole supplier to the US Navy of the aircraft-launched standoff decoys which appear as "dummy" targets on enemy radar screens. By replicating fighter aircraft, ITALDs suppress enemy missile effectiveness and support air-to-surface missions while assuring crew safety and aircraft survivability. The new contract is valued at approximately $22 million.

"We are very pleased to have received this contract," says Mr. Mizrachi, Chairman of IMI. "ITALD is an advanced version of our combat-proven TALDs, which have repeatedly demonstrated their ability to saturate enemy radar screens and divert enemy anti-aircraft activity. During the Gulf War, TALDs

created safe corridors for US and allied aircraft on route to Iraqi targets. The upgraded ITALD was created in light of the TALDs' success."

ITALDs may be deployed in the event of a US assault on Iraq. "With plans calling for a focus on Baghdad and the country's ports, the need to counter and knock out Iraq's air defense systems will play a key role in the operation", Mizrachi says.

Black Sparrow

Armed services around the world are faced with the proliferating threat of theater ballistic missile (TBM) attack. As the threat grows, so does the need to train in a realistic TBM environment.

The Black Sparrow air-launched ballistic target provides a flexible, threat-representative, and affordable solution to the demands of live-fire TBM interceptor test and evaluation. It has been operationally proven in missile defense engagements using the Israeli Arrow Weapon System (AWS). Black Sparrow began its development phase in 1996 and is currently in production.

Black Sparrow's performance, fidelity, logistics, and low cost of ownership make it an ideal choice for land and sea-based TBM interceptor live-fire exercises. Black Sparrow offers a reliable, low-risk alternative to established TBM target products.

Performance

Air-launched operation provides the flexibility for interceptor engagement testing over land and sea. Aerial target delivery enables the user to emulate different engagement scenarios, including mass-raid testing.

Safety is a critical live-fire test consideration. Black Sparrow incorporates a fully-redundant flight termination system (FTS) that complies with strict range safety requirements. GPS, telemetry, and transponder electronics for range tracking are standard target features. Black Sparrow minimizes environmental hazard by eliminating liquid fuel and jettisoned booster motors.

Downrange and crossrange accuracies guarantee that the target will arrive at desired launch range coordinates. Black Sparrow ensures a successful test, on time and on target.

Fidelity

Black Sparrow simulates the trajectory (velocity and altitude), thermal image, and radar cross section (RCS) of established short-range ballistic missile threats. The target can perform one of three different re-entry scenarios during its terminal phase of flight. It can maintain its ballistic trajectory, maneuver, or disintegrate into three parts by activating the FTS. These fidelity features are ideal for evaluating interceptor performance and land or sea-based sensor discrimination.

The modular warhead simulator can be adapted to emulate a variety of Re-entry Vehicle threats (e.g. high explosive, WMD, etc.). It is also suitable for delivering TBM payloads such as Electronic Counter-Measure suites. Black Sparrow can incorporate optional miss distance or hit indication instrumentation for interceptor lethality analysis.

Logistics

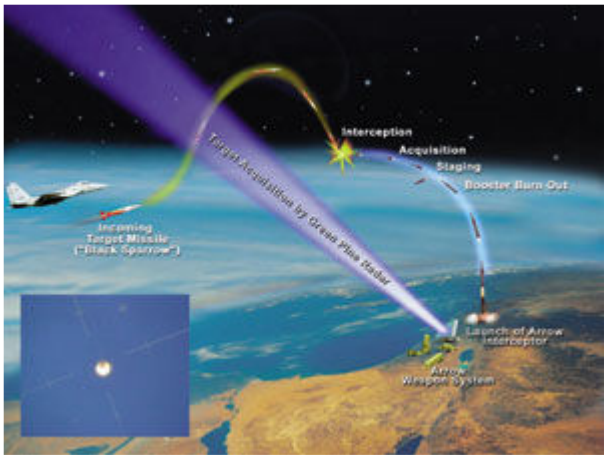
Black Sparrow is lightweight and portable. Targets are shipped as "wooden rounds" from the factory, eliminating the need for on-site final integration.

Target presentation does not depend on ground-based launch infrastructure. Flight trajectories are programmed into the target at the launch range using a mobile test station.

Black Sparrow can be launched from several aircraft platforms, including the F-15, F-4, F-111, and B-52. Minimal effort is required to integrate Black Sparrow on new platforms.

Nominal launch conditions require straight and level flight, eliminating the need for special pilot training. The target separates safely from the aircraft via free drop at the launch point.

Arrow Weapon System was tested on the Black Sparrow



An IAI Arrow II anti-ballistic missile successfully intercepted (see insert) a Rafael Black Sparrow target on 14 September 2000. The principle of the intercept test - the seventh successful out of eight and third out of three system tests according to the Israeli Ministry of Defence - is clearly illustrated in this sketch and also involved the Elta Green Pine radar and the Tadiran Citron Tree fire control centre. The air-launched Black Sparrow simulated the incoming ballistic missile.

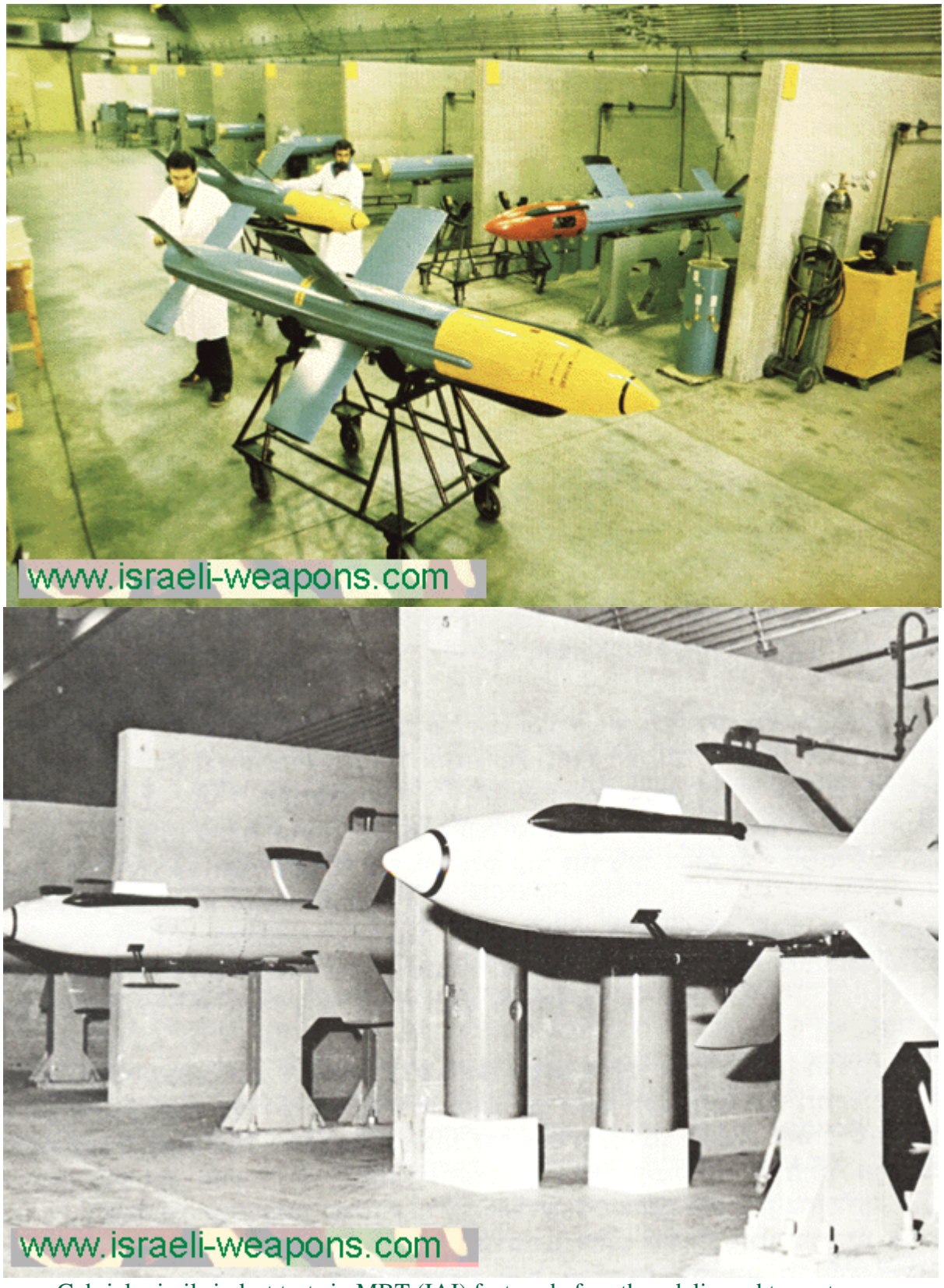
Raytheon teams with RAFAEL to market and manufacture air-launched ballistic target

Raytheon Company has signed a teaming agreement with RAFAEL to market and manufacture the Black Sparrow air-launched ballistic target. Raytheon was selected from among five American firms for the partnership.

The partnership provides RAFAEL with a marketing and distribution channel in the United States for Black Sparrow and offers Raytheon a new, world-class product to meet the demand for cost-effective targets for theater ballistic missile defense system evaluation. Raytheon's Missile Systems business unit in Tucson, Ariz., is representing the Black Sparrow program for potential United States customers.

Gabriel

www.israeli-weapons.com



Gabriel missils in last tests in MBT (IAI) factory before they delivered to customer.

GABRIEL PROPULSION SYSTEM
Booster and sustainer motors for the Gabriel II.

Gabriel - IAI / MBT began to develop the first sea to sea missile in 1962, and revealed to public at first time in 8.5.1970.

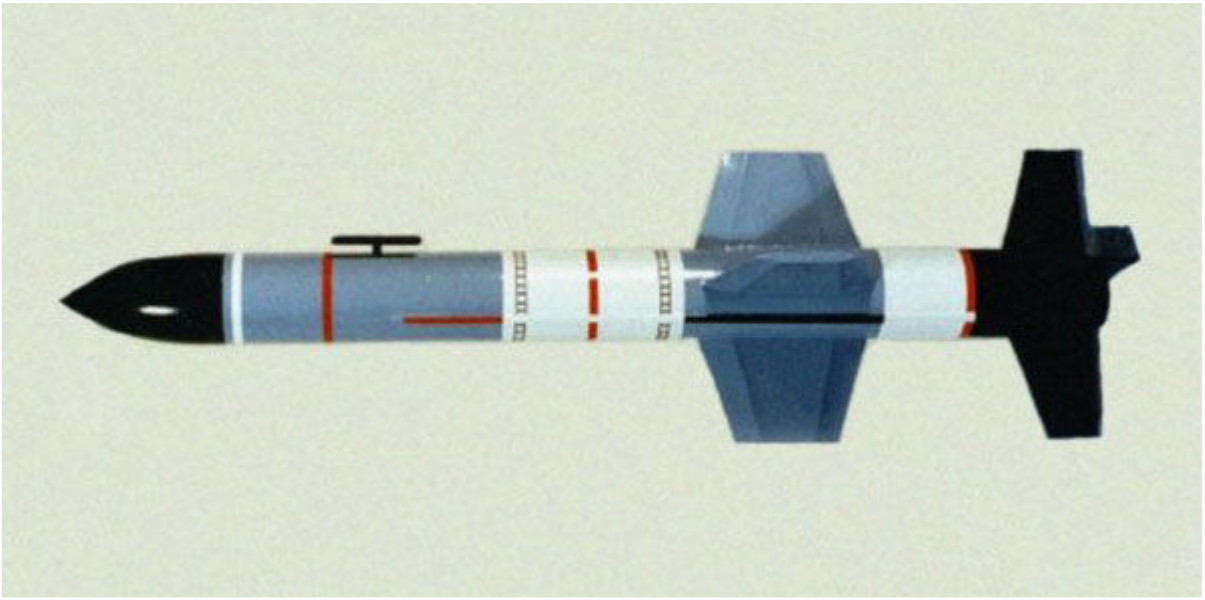
This challenge was met with the development of an original approach to missile guidance, resulting in the creation of the Gabriel - the world's first operational, sea-skimming missile.
The Gabriel missile system gave the Israel Navy an unprecedented combat capability as demonstrated during the 1973 Yom Kippur War .

Missile upgrading - A cost-effective way to extend the life of a missile system is to upgrade its guidance system. IAI's Electronics Group / MBT has employed this technique in different missile systems, using various types of seekers based on advanced signal processing techniques, artificial intelligence, multi-tasking, multi-processing, and secure communication systems.

Advanced Missiles - MBT is currently developing the next generation of naval missiles and weapon control systems, utilizing the most sophisticated concepts. The new missile will be able to penetrate both softkill and hardkill defenses.

	Gabriel Mk 1	Gabriel Mk 2
Length	335 cm	336 cm
Span	135 cm	135 cm
Body	33 cm	33 cm
Weight	430 kg	520 kg (warhead 100 kg)
Guidance	IAI	IAI
Guidance Type	Semiactive	Semiactive
Model		2-stage spr.
Range	20 km	6 to 36 km
Speed	0.6 Mach	0.6 Mach

Gabriel III



Gabriel Mk 3 A/S

The Gabriel has been successively updated to the current "Gabriel III" missile, with twice the range and a substantially different external appearance from the Gabriel I. It is available in both ship-launched and air-launched versions, with the air-launched version known as the Gabriel III "A/S" (Air to Surface).

The Gabriel III A/S is powered by a stubby cruciform wings fitted to the midsection and cruciform tailfins for guidance. It has boost-sustain solid rocket motor and is fitted with a SAP warhead.

While the Gabriel I used a semiactive radar homing seeker that required the launch platform to keep the target illuminated by radar, the Gabriel III has a dual-mode seeker that can be operated in "fire and forget" or "fire and update" modes.

In the "fire and forget" mode, the Gabriel III is guided by an INS into the target area, with altitude maintained by a radar altimeter. It then turns on its active radar seeker to lock onto and attack the target after a search. In the "fire and update" mode, the missile can receive course corrections from the launch aircraft while it is cruising towards the target, allowing it to keep its radar seeker off until the last moment.

The Israeli Gabriel III A/S is an advanced offshoot of the original Gabriel ship-to-ship missile system. The original Gabriel was a small, canister fired sea skimmer, designed to attack enemy vessels at wavetop level, making its approach extremely hard to detect. This newer, air-launched version is larger, with a range of 60+ km, and carries a high-explosive warhead weighing 150 kg. The guidance system of the Gabriel III/AS enables it to fly so low that it must be pre-set according to the current size of the waves.

	Gabriel Mk 3	Gabriel Mk 3 A/S
Category	Anti-Ship	Anti-Ship (Air Launch)
Length	375 cm	378 cm
Span	132 cm	108 cm
Body	33 cm	33 cm
Weight	560 kg (warhead 150 kg)	590 kg (warhead 150 kg)

Guidance	IAI	IAI
Guidance Type	Active	Active
Model	2-stage spr.	1-stage spr.
Range	36 km	60+ km
Speed	0.7 Mach	0.7 Mach
Status	Antiship sea skimmer	Air launch version Entered Service 1982

Gabriel IV

There is apparently a new long-range turbojet-powered version of the Gabriel, the "Gabriel IVLR", and some sources state that Denel of South Africa has also built a 150 kilogram submunition warhead for the Gabriel. This unusual warhead has a main charge and 35 fragmenting submunitions that detonate in sequence at 5 millisecond intervals, with the fragments heavy enough to penetrate bulkheads.

	Gabriel IV
Range	200 km
Weight	960 kg (warhead 240 kg)
Length	470 cm
Core Diameter	44 cm
Span	160 cm

Arrow

IAI
arrow
IAI
MLM DIVISION
arrow

RIT2-1
20AUG1996

The Arrow, an anti-ballistic missile system, is displayed for the first time at The Palmachim Air base in Israel, November 7, 2002. The missile, untested in combat, will be Israel's last line of defense if Iraq responds to a U.S. attack by launching Scud missiles against the Jewish state.

An Arrow missile interceptor is launched over the Mediterranean Sea from the Palmachim air base on January 5, 2003

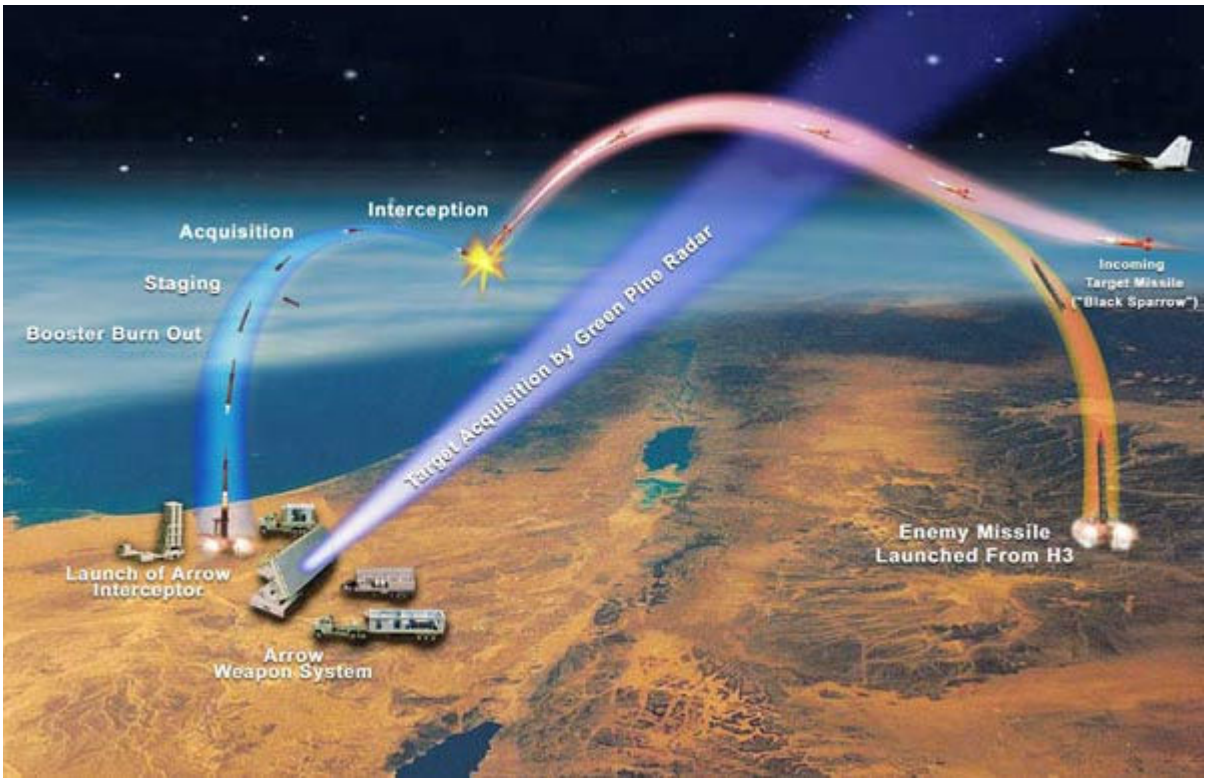
The Arrow 2 theatre ballistic missile defence system has been developed by the MLM Division of Israel Aircraft Industries and is in operation with the Israeli Defence Forces. The system, carrying the codename Homa or Fence, is to be deployed in three batteries including one battery near Tel Aviv and one to the south of Haifa. The first battery became operational in 2000.

The demonstrator phase of the program began in 1988 when the US Department of Defense Strategic Defence Initiative placed a contract on the Electronics Division of Israel Aircraft Industries to build and test the Chetz-1 (Hebrew name for Arrow 1) Anti Tactical Ballistic Missile (ATBM) system. Following the successful completion of the demonstrator tests, the system entered full-scale development and production. The weight of the Arrow 1 was 2,000kg. A new missile was developed, the Arrow 2, with a launch weight of 1,300kg, which was first tested in 1995. Arrow 2 has successfully acquired, tracked and destroyed TM-91 Arrow missile targets from ranges of 60km and 100km. Further Arrow Weapon System developments have been planned and will be funded by Israel and the USA.

In February 2003, IAI signed an agreement with Boeing to establish the production infrastructure to manufacture components of the Arrow missile in the US. Boeing will be responsible for the production of approximately 50% of the missile components in the US. Boeing will produce various missile components and co-ordinate the production of existing Arrow missile components already being manufactured by more than 150 American companies. IAI will be responsible for integration and final assembly of the missile in Israel.

An Arrow Weapon System battery is equipped with typically four or eight launch trailers, each with six launch tubes and ready-to-fire missiles, a truck mounted Hazelnut Tree Launch Control Centre, a truck mounted communications centre, a trailer mounted Citron Tree fire control centre and the units of a mobile Green Pine radar system.

The Arrow 2 missile approaches the target at a maximum speed of Mach 9, or 2.5km/s, to a maximum altitude of 50,000km.



Israel began work on a potential theater missile defense (TMD) system in 1986, with the signing of a Memorandum of Understanding (MOU) with the United States. While the threat posed by ballistic missiles has been a concern for Israel since the mid-1980s, Iraqi ballistic missile attacks during the Gulf War in 1991 underscored the danger posed by the buildup of missile technology in the region. Given the lack of available Israeli resources for TMD development, the United States agreed to co-fund and co-develop an indigenously-produced Israeli TMD system. In 1988, the US and Israel began what was to evolve into a three-phase program to develop the ARROW series of Anti-Tactical Ballistic Missiles (ATBMs). First test launch of Arrow missile was in 9.8.1990.

Arrow II is intended to satisfy the Israeli requirement for an interceptor for defense of military assets and population centers and will support US technology base requirements for new advanced anti-tactical ballistic missile technologies that could be incorporated into the US theater missile defense systems. The Arrow missile, a joint international project with Israel, is a long-range interceptor that offers the United States technology infusion, including lethality data; development of optical window technology applicable to both THAAD and Navy Area Defense programs; data from stage separation at high velocities and dynamic pressures; and, interoperability development that will allow synergistic operations of Arrow with US TMD systems, if required in future contingencies.

The Citron Tree battle management center, built by Tadiran, guides the Arrow 2 interceptor, developed by Israel Aircraft Industries' MLM Division. The entire anti-tactical ballistic missile project is called Homa.

The joint effort took a dramatic step forward during the summer of 1995 with the first test flight of the new “Arrow 2.” A year earlier, an experimental Arrow 1 missile intercepted and completely destroyed a target missile in Israel. Flight tests of the Arrow 2 are continuing. On September 14, 1998, a successful test was conducted. On November 1, 1999, a successful test of the Arrow was conducted by the Israeli Air Force and Israel deployed the first battery of Arrow missiles on March 14, 2000.

The system is designed to intercept as many as 14 incoming missiles. The first test of its ability to launch multiple missiles at different targets was conducted in January 2003. In seven interception tests, six have been successful.

The system's development is jointly funded by the United States and Israel. Since 1988, the United States has provided Israel with more than $628 million in grants for research and development of the Arrow through the defense budget. When fully deployed, Israel will have paid for 60% of the program, which is ultimately expected to cost about $1 billion.

Two Arrow batteries have been deployed, one at the Palmachim base to provide cover for Tel Aviv and another near the city of Hadera. A third battery is in development

Arrow 2 ATBM Missile

The two-stage missile is equipped with solid propellant booster and sustainer rocket motors. The missile uses an initial burn to carry out a vertical hot launch from the container and a secondary burn to sustain the missile's trajectory towards the target at a maximum speed of Mach 9, or 2.5km/s. Thrust vector control is used in the boost and sustainer phases of flight. At the ignition of the second stage sustainer motor, the first stage assembly separates.

The Arrow missile is launched before the threat missile's trajectory and intercept point are accurately known. As more trajectory data becomes available, the optimum intercept point is more precisely

defined and the missile is guided towards the optimum intercept point.

The kill vehicle section of the missile, containing the warhead, fusing and the terminal seeker, is equipped with four aerodynamically controlled moving fins to give low altitude interception capability. The warhead is a high explosive directed blast fragmentation warhead developed by Rafael, which is capable of destroying a target within a 50m radius. The dual mode missile seeker has a passive infrared seeker for the acquisition and tracking of tactical ballistic missiles and an active radar seeker used to home on air breathing targets at low altitudes. The infrared seeker is an indium antimonide focal plane array developed by Raytheon (formerly Amber Engineering).

The intercept altitudes are from a minimum of 10km up to a maximum of 50km. The maximum intercept range is approx. 90km

The system's operational features and requirements

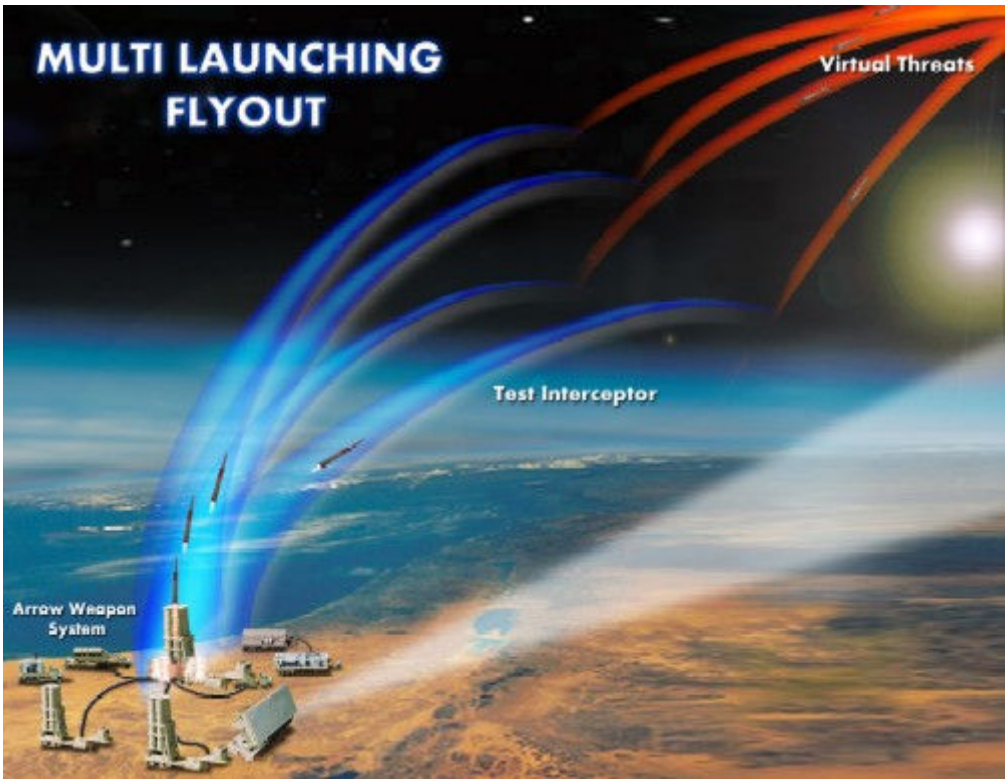
Powerful & Effective

Large area of defense in a stand-alone mode.
Highly lethal against various types of Theater Ballistic Missiles and warheads.
Multi-TBM salvo interception.
High and low altitude interception capability.
Early-warning target. identification, launch and impact- point location capability.
Modular, easily expandable baseline solution.
Open architecture facilitating interoperability with other air defense systems.

Flexible & Adaptive

Open system architecture allowing interoperability with other air defense systems.
Modular, easily expandable baseline solution.
Flexible management of weapon system resources.
Fully automatic, as well as "man-in-the loop" options for battle operations management.
Transportable system elements.

The Arrow 2 system can detect and track incoming missiles as far way as 500 km and can intercept missiles 50-90 km away [some sources suggest the engagement range is 16 to 48km]. The Arrow 2 uses a terminally-guided interceptor warhead to destroy an incoming missile from its launch at an altitude of 10 to 40km at nine times the speed of sound. Since the missile does not need to directly hit the target--detonation within 40-50 meters is sufficient to disable an incoming warhead. The command and control system is designed to respond to as many as 14 simultaneous intercepts.



The system's components

Long Range Acquisition Radar (Green Pine)

The Elta Green Pine early warning and fire control radar for the Arrow system. The radar can detect targets at ranges up to about 500km and is able to track targets at speeds over 3,000m/s.

The Arrow Weapon System features a state-of-the-art EL/M2080 L-band radar, Green Pine, based on the decades of experience in developing technological solutions for early warning and fire control defense systems.

The Elta Electronic Industries subsidiary of IAI Electronic Group developed the Green Pine early warning and fire control radar for the Arrow system. The radar carries the designation EL/M-2090 and includes the trailer mounted radar and antenna array, the power generator, a cooling system and a radar control centre.

Green Pine is an electronically scanned, solid state, phased array radar operating at L-band in the range 500MHz to 1,000MHz, and was developed from the Elta Music phased array radar. The radar operates in search, detection, tracking and missile guidance modes simultaneously.

The radar can detect targets at ranges up to about 500km and is able to track targets up to speeds over 3,000m/s. The radar illuminates the target and guides the Arrow missile to within 4m of the target.

The radar has the following features:

Phased array L-band radar
Dual mode operation - early warning and fire control
Long range acquisition capability - several hundred kilometers
Simultaneous tracking of dozens of Tactical Ballistic Missiles (TBM)

Clear discrimination between TBMs, aircraft and other missiles
ECCM capability
Transportability
India has placed an order for the supply of two Elta Green Pine for use with India's air defence system against ballistic missiles. The first was delivered in 2001. The Green Pine Radar system is already deployed in India. The radar system, developed for Israel's Arrow anti-missile missile, is a transportable ground-based multimode solid-state phased array radar, capable of predicting impact points of incoming tactical ballistic missiles.

The Green Pine radar's strategic value along the Indian-Pakistani border is reportedly inestimable. "It covers all of Pakistan's military command centers and bases between Islamabad, the capital, and the Indian frontier. The system reportedly provides India with surveillance of Pakistan's nuclear centers and missile sites

Arrow 2 Launcher

Developed and produced by the MLM Division of IAI.

Launcher features:

Vertical hot launch from a sealed canister.
All-azimuth coverage.
6 canisters per launcher.
Full redundancy for maximum system availability.
Fast reaction time.
Transportable.

Hazelnut Tree Launch Control Center - LCC

Developed and produced by the MLM Division of IAI.

The LCC is located at the launch site and operates as an interface between the Fire Control Center (FCC) and launchers, receiving inputsfrom the FCC and activating the launchers.

LCC's main features are:

Fully automatic battle management code.
Fully redundant system.
Communication junction.
Missile maintenance and diagnostic capability.
High confidence levels,multiple independent safety switch preventing inadvertent launches.

Citron Tree Fire Control Center - FCC

Tadiran Electronics Limited is the prime contractor for the Citron Tree battle management / fire control centre. Citron Tree, which is trailer mounted, downloads the radar data along with data from other sources and uses powerful signal processing tools to manage the threat interceptions fully

automatically, including against single and multiple threats. The system has man-in-the-loop intervention capability at every stage.

The fire control and battle management centre has computer workstations for the Sky Situation Co-ordinator, Intelligence Officer, Post Mission Analysis Officer, Resource Officer and Senior Engagement Officer as well as the Commander's station. The workstations display a large electronic map showing the area of battle. Predicted and confirmed launch sites are colour coded to show priority sites.

When a missile launch is detected, the launch site, the missile's position and trajectory and the predicted impact point are displayed on the electronic map. The predicted impact point is displayed as an ellipse on the map. The size of the impact ellipse shrinks as the missile's trajectory stabilises and the trajectory data becomes available. The trajectory image is colour matched to the image of its launch site. The optimum intercept point is also displayed. The centre can control up to 14 intercepts simultaneously.

Link 16, Tadil J, communications is being developed to allow interoperability with Patriot fire control units. Assigned targets can be handed over to the Patriot's N/MPQ fire control radar. Tests carried out by the US and Israel have successfully linked the Arrow and US Patriot and also the Arrow and Israeli Defence Force Patriot version.

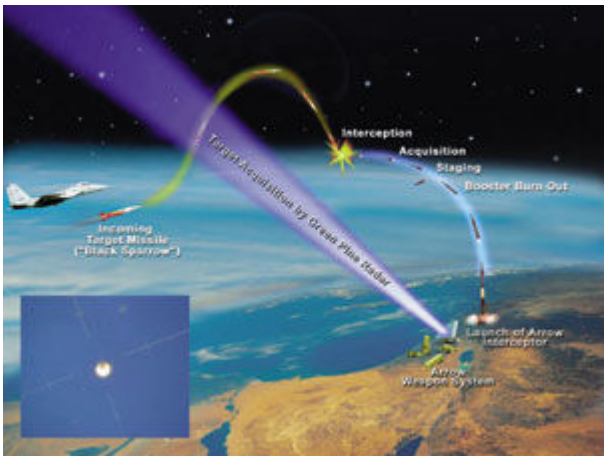
FCCs main functions include:

Processing of the data.
Threat assessment.
Optimization of interception.
Mission control.

FCCs main features are:

Manual and/or fully automatic battle management modes.
Simultaneous handling of dozens of threats.
Open system architecture (interoperability features).
Cue to or from other weapon systems.
Advanced Man Machine Interface (MMI) based on the experience of IDF operators.
Full simulation capability for pre-mission planning.
Overall recording & playback for post-mission debriefing.
Transportability.

Series of Tests



Arrow 1 tests:

Test 1 (August 9th, 1990): Designed to test the control system the sensing devices that are being carried by the missile and guide it to its target during the launch. The test came to a halt seconds after take off and the missile was intentionally destroyed by an order from the ground due to fear it might ward off and hit a settlement. Cause of malfunction: the ground tracking radars were not successful at tracking the missiles' flight.

Test 2 (March 25th, 1991): Designed to test the missile's system during launch. The test was conducted on

a ship at sea. Malfunction in the missile resulted in the abortion of the experiment.

Test 3 (October 31st, 1991): Designed to test the Arrow's interception ability. The missile was launched from a ship at sea as well, however, the same causes for the previous tests' abortion reappeared, resulting in the abortion of this test as well.

Test 4 (September 23rd, 1992): Designed to test the missile's system during launch. The systems operated as plan and the Arrow reached it's designated point in the sky. The missile was destroyed, as planned, 45 seconds later. This successful experiment ended the system's preliminary testing phase.

Test 5 (February 28th, 1993): Designed to test the missile's interception abilities. The Arrow managed to pass by very closely to the target missile. For the first time, the Arrow's ability to intercept Surface-to-Surface missiles was proven.

Test 6 (July 14th, 1993): Designed to test the missile's interception abilities. The Arrow managed to pass by very closely to the target missile.

Test 7 (October 14th, 1993): Designed for system examination. The Arrow managed to pass by very closely to the target missile.

Test 8 (March 1st, 1994): The missile was not launched due to ground computer failure.

Test 9 (June 12, 1994): The missile was launched against a target missile and successfully intercepted it.

Arrow 2 tests:

Test 1 (July 30th, 1995): Designed to test the steering, control and cruising systems of the Arrow. The test was conducted without a target missile.

Test 2 (February 20th, 1996): Another successful experiment. This time a target missile had not been launched as well.

Test 3 (August 20th, 1996): Successful interception. The Arrow successfully destroyed the target missile.

Test 4: (March 11th, 1997): Another successful interception. The Arrow destroyed the target missile this time as well.

Test 5 (August 20th, 1997): The missile was destroyed by ground orders due to malfunction in the missile's steering system.

Test 6 (September 14th, 1998): The missile was launched towards a virtual target created by a simulator. The test was successful.

Test 7 (November 1st, 1999): Full systems test. The missile was launched towards a virtual Scud target and successfully managed to hit and destroy it.

Test 8 (September 14th, 2000): The Arrow was launched towards the target missile Black Sparrow launched from an F-15 fighter jet simulating a Scud. The Arrow hit and destroyed the target.

Test 9 (August 28th, 2001): Full systems test wherein the Arrow was launched towards a Black Sparrow target missile, simulating a ballistic missile flight. The interception was conducted at a range larger than 100 kilometers at higher altitudes than before. The Arrow hit its target and destroyed it.

Test 10 (January 5th, 2003): Full systems test that did not include interception. Four missiles were launched towards four simulation targets in order to examine the interceptor's performance on special flight conditions and the system's ability at a sequence of launches.

Test 11 (December 16th, 2003): An test that examined the improved systems added as a result of a

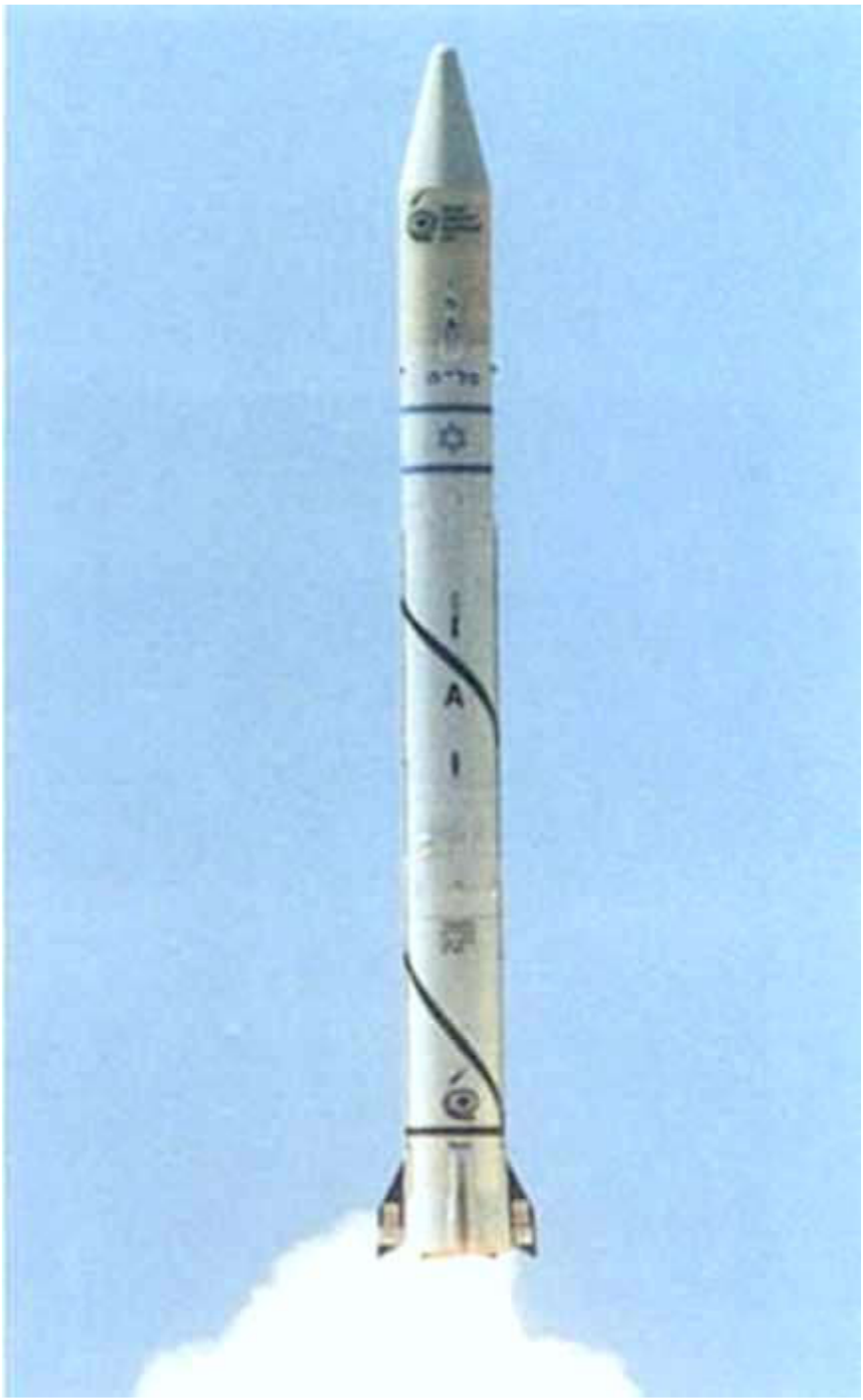
contract with the US, enabling the Arrow to intercept at a high ceiling.

Over the following years more tests are expected aimed to examine the missile's efficiency and to test for possible malfunctions.

Missile	

Missile diameter	800mm
Missile launch weight	1,300kg
Launch canisters per launcher	6
Radar	
Radar frequency	L band
Detection range	500km
Target speed	Over 3km/s
Missile guidance to distance from target	4m from target
Missile Performance	
Missile velocity	Mach 9
Maximum range	70.0km
Maximum range of flight	90.0km
Minimum altitude	8,000m

Shavit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SHAVIT launcher with OFEQ 5
launched Westward on 28th of May 2002 at 18:25 pm (in Israeli time).

The global market trend towards the use of smaller satellites for remote sensing, telecommunications, science and other commercial, civilian and military applications is the major driver for MLM the Systems Division of Israel Aircraft Industries (IAI) to offer orbit insertion services using its SHAVIT family of satellite launchers.

IAI/MLM's Division SHAVIT launcher offers various options for launching small satellites into Low Earth Orbit (LEO). The launch system is based on flight-proven hardware and software, and a unique integration and launch concept. These reduce significantly launch preparation time, and, consequently lower overall launch costs.

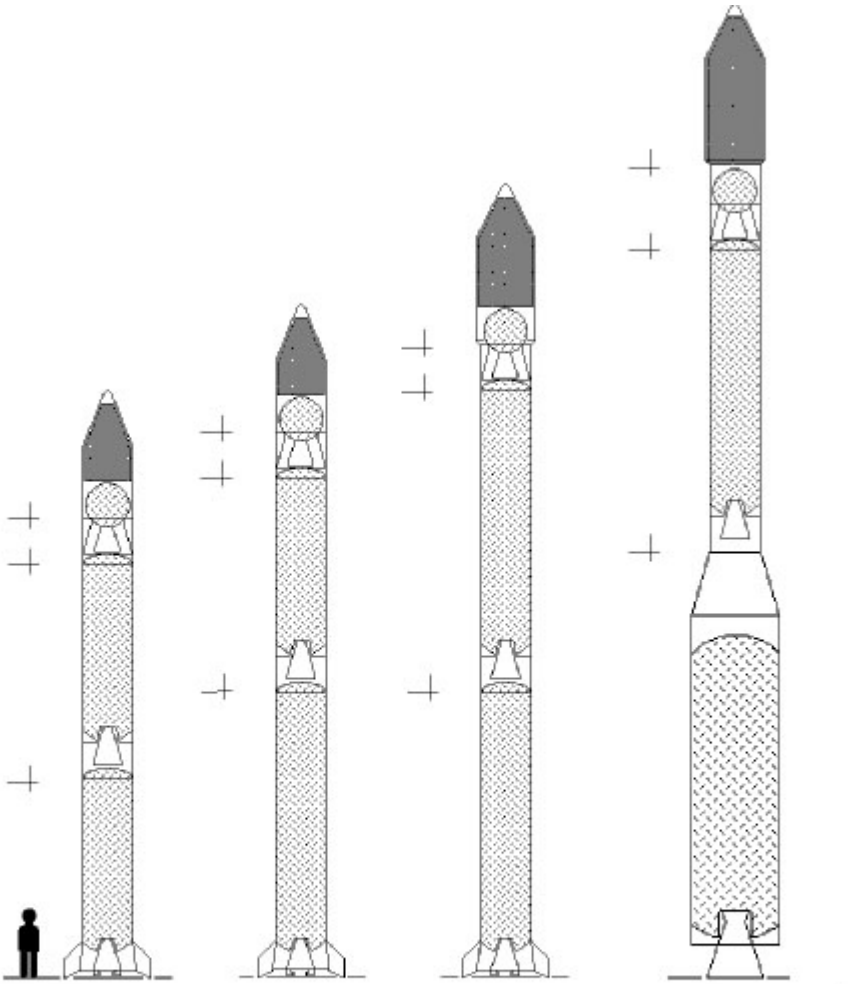
MLM developed, produced and launched the SHAVIT launcher that is responsible for placing Israel's OFEQ satellites in space including OFEQ 5 that was launched Westward on 28th of May 2002 at 18:25 pm (Israel time).

SHAVIT is a three-stage satellite launcher, powered by three solid fuel rocket motors. The first two stages lift the launcher to an altitude of approximately 110 km. From this point, the launcher continues to gain height while coasting up to approximately 250 km, where the launcher positions itself and ejects the satellite shroud. After the separation of the main instrumentation compartment and while the launcher is spinning, the third stage motor is ignited. Thus, the satellite is inserted accurately into its transfer orbit at an altitude of approximately 260 km. Some analysts have speculated that the Jericho 2 is simply is the first two stages of the Shavit SLV.

Shavit is a 3-stage solid launcher whose 2 first stages are inherited from Jericho 2. All three stages use solid motors. The first- and second-stage motors were identical with differences in the expansion ratio of the nozzles. The third stage motor built by Raphael. The two first stages have a composit structure. They are identical and weigh 13 tons. The third stage is spherical, with a titanium structure. It weighs 2,6 tons and its 59 kN motor burns during 92.5 seconds. The equipment case with its rotation table is located under the third stage and is jettisoned before its ignition.

The Shavit-1 has an upgraded first stage. The first stage is stretched for higher propellant load. The Shavit launches take place from the Palmahim air force base, south of Tel Aviv.
A planned commercial Shavit upgrade called Next. This name is no longer used, and this proposed upgrade configuration is now called Shavit-2. Both first and second stages of the Shavit-2 use the stretched motor design of the Shavit-1 first stage. The third stage may be a standard AUS-51 motor built under license by Atlantic Research Corp.

IAI/MLM Division leads the Israeli space industry into the international commercial satellite launching market. Through strategic alliances, and constantly improving its launcher diversity, MLM continues to pursue multi-sensor micro satellite and airborne launching capabilities further improving its competitive position in this market.



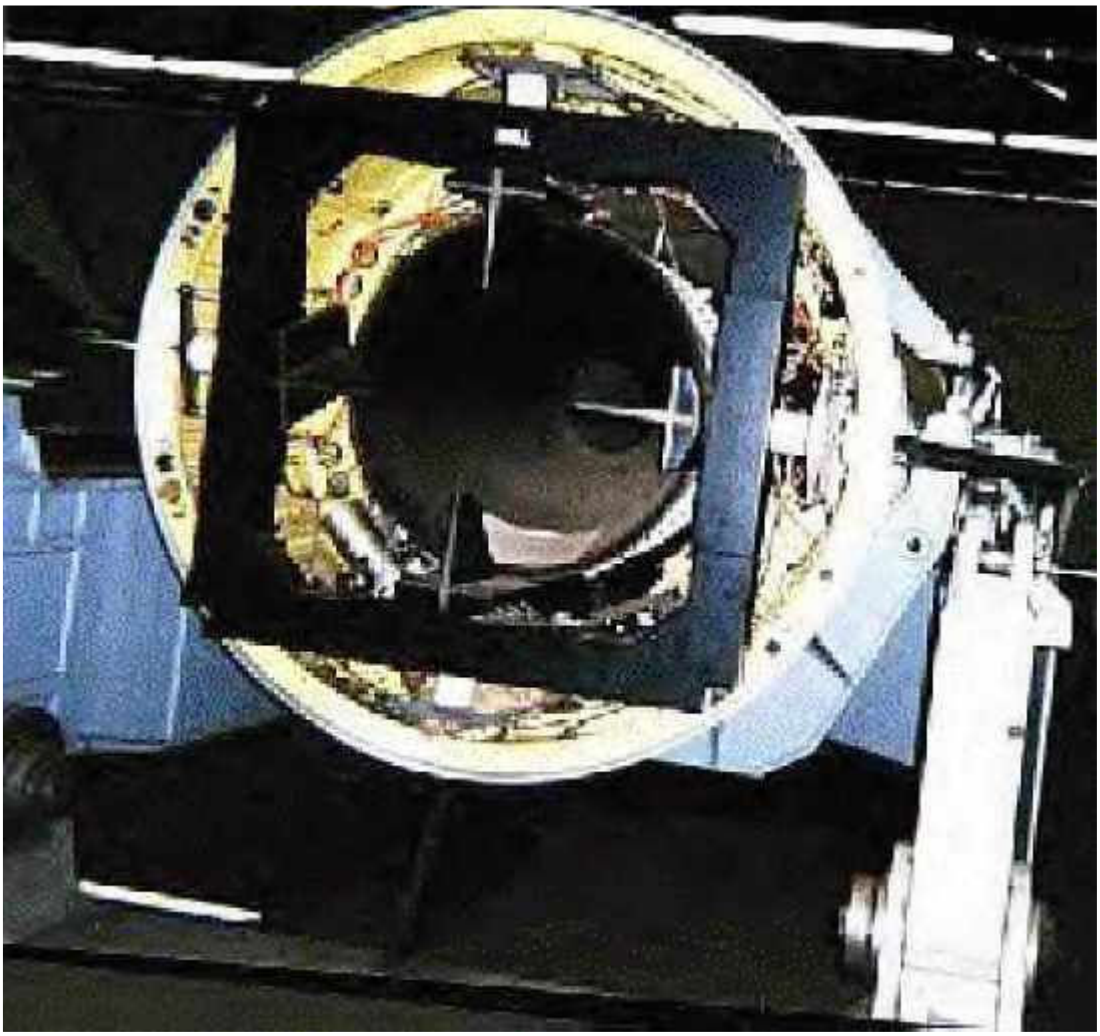
version	stage 1	stage 2	stage 3	stage 4
Shavit	ATSM-9	ATSM-9	AUS-51	
Shavit 1	ATSM-13	ATSM-9	AUS-51	
Shavit 2 (LK-1)	ATSM-13	ATSM-13	AUS-51	
Shavit 3 (LK 2)	Castor 120	ATSM-13	AUS-51 or Star-48	PEPT-420

SHAVIT utilizes a unique set of launch preparation equipment. It is largely independent of the launch site and provides full testing of the launcher on the launch pad. This configuration enables satellite launch from different launch sites, according to customer requirements.

The LEOLINK program was initiated to market IAI/MLM Division's launch services for the global market using the current LK-A (Shavit 1) launcher, while developing LK-1 and LK-2, its next generation launchers:

LK-A - For 350kg-class satellites in 240x600km elliptical polar orbits.
LK-1 - For 350kg-class satellites in 700km circular polar orbits.
LK-2 - For 800kg-class satellites in 700km circular polar orbits
A Shavit LK air launched satellite launcher is being proposed by ISA and Israel Aircraft Industries. The booster would be a standard Shavit-1 without a first stage that would be dropped from a Hercules C-130 aircraft.

The LK-1 is closely based on the Shavit-2, a planned follow-on to the Shavit-1, but the motors and other components will be built in the United States. The LK-2 is a larger vehicle that will use a Thiokol Castor 120 motor as its first stage. The third stage may be either a standard AUS-51 motor built under license by Atlantic Research Corp., or a Thiokol Star 48 motor. All launch vehicles have a small monopropellant hydrazine fourth stage.



RSA-3-1.

Hydrazine-motor PEPT-420.

AUS-51 Advanced Upper Stage Motor, used to insert OFFEQ satellites into orbit.

Shavit (RSA-3)

Stage	Engines	Thrust s.l.	Isp s.l.	Thrust vac	Isp vac	Propellant	Burn time	Flow rate	Total Imp
-	-	kN	N*s/kg	kN	N*s/kg	tons	s	t/s	MN*s
1	**ATSM-9**	412,6	2334	456,0	2579	9,10	51,5	0,1767	**23,5**
2	**ATSM-9**			471,1	2697	9,10	52,1	0,1747	**24,5**
3	**AUS-51**			58,8	2864	1,895	92,5	0,0205	**5,4**

Shavit-1

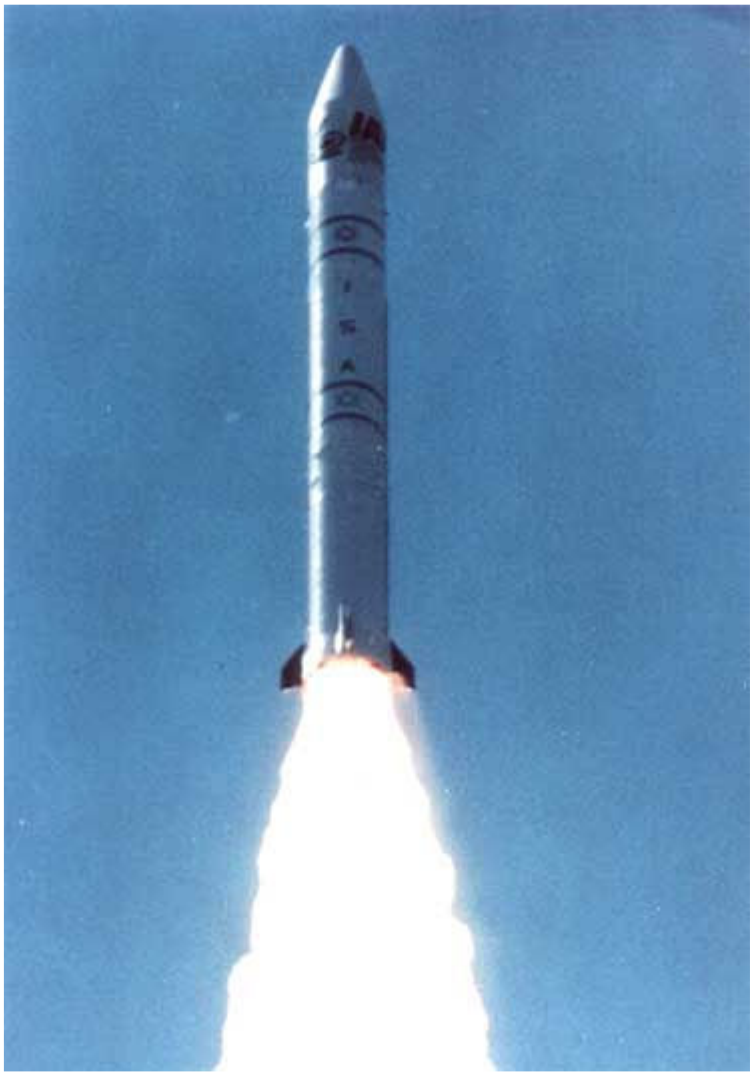
Stage	Engines	Thrust s.l.	Isp s.l.	Thrust vac	Isp vac	Propellant	Burn time	Flow rate	Total Imp
-	-	kN	N*s/kg	kN	N*s/kg	tons	s	t/s	MN*s
1	**ATSM-13**	552,5	2363	610	2608	12,75	54,5	0,2338	**33,2**
2	**ATSM-9**			564	2707	9,10	43,7	0,2082	**24,6**
3	**AUS-51**			59,3	2898	1,895	92,5	0,0205	**5,5**

Shavit-2 (LK-1)

Stage	Engines	Thrust s.l.	Isp s.l.	Thrust vac	Isp vac	Propellant	Burn time	Flow rate	Total Imp
-	-	kN	N*s/kg	kN	N*s/kg	tons	s	t/s	MN*s
1	**ATSM-13**	704,5	2452	775	2697	12,75	44,4	0,2872	**34,4**
2	**ATSM-13**			835	2736	12,75	41,8	0,3050	**34,9**
3	**AUS-51**			59,3	2898	1,895	92,5	0,0205	**5,5**

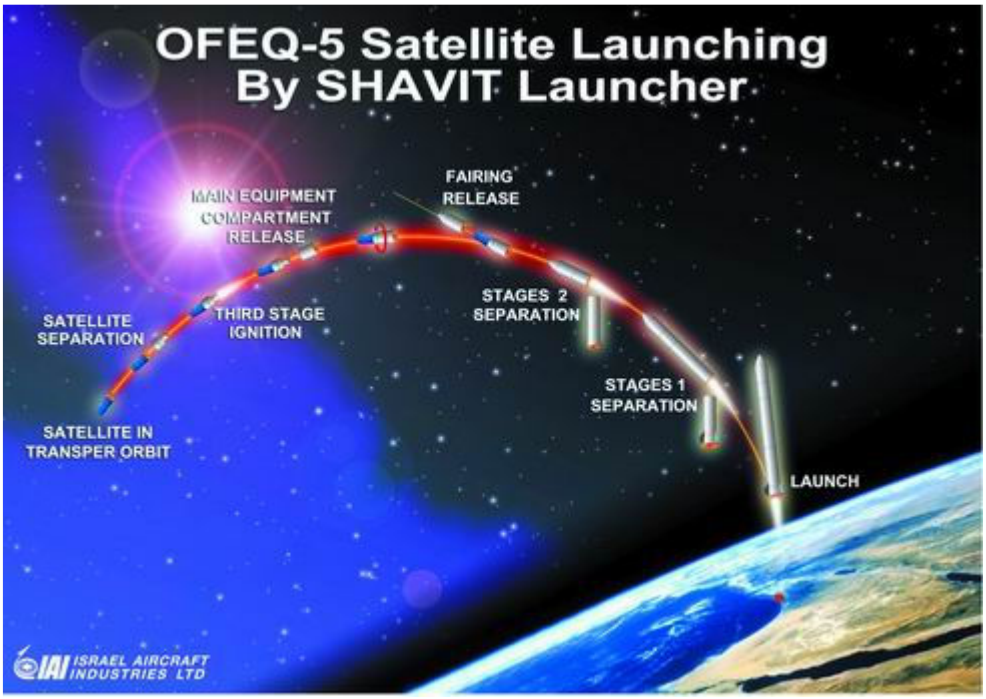
Shavit-3 (LK-2)

Stage	Engines	Thrust s.l.	Isp s.l.	Thrust vac	Isp vac	Propellant	Burn time	Flow rate	Total Imp
-	-	kN	N*s/kg	kN	N*s/kg	tons	s	t/s	MN*s
1	**Castor 120**	1483,7	2481	1650,3	2760	49,024	82	0,5980	**135,3**
2	**ATSM-13**			835	2736	12,75	41,8	0,3050	**34,9**
3	**AUS-51**			59,3	2898	1,895	92,5	0,0205	**5,5**
4	**PEPT-420**			0,40	2246 (?)	0,071	400	0,0002	**0,16**



Israel Space Agency (I.S.A.)			Shavit (RSA-3)	Shavit-1 (LK-A)	Shavit-2 (LK-1)	Shavit-3 (LK-2)
Overall Vehicle	Operational	from	19.09.1988	05.04.1995		
		to	15.09.1994	28.05.2002		
	Orbital flights		**3**	**3**	**0**	**0**
	Payload weight	t	Mission 0,160	Mission 0,225	LEO 0,55	LEO 1,55
	Gross liftoff weight	t	23,39	27,25	31,40	72,30
	Gross propellant weight	t	20,10	23,75	27,40	63,67
	Total length	m	15,43	17,70	20,87	26,40
	Max. diameter (span)	m	2,30	2,30	2,30	2,36
	Total liftoff thrust (s.l.)	kN	412,7	552,5	704,5	1.484
	Total impulse (vac)	MN*s	**53,4**	**63,3**	**74,8**	**175,7**
Fairing	Total length	m	3,35	3,35	5,40	5,40
	Diameter	m	1,35	1,35	1,56	1,56
	Total weight	t	0,057	0,057	0,108	0,108
Stage 3	**Name**		**AUS-51**	**AUS-51**	**AUS-51**	**AUS-51**

	Length	m	1,15 (2,13)	1,15 (2,13)	1,15 (2,13)	2,13
	Diameter	m	1,30	1,30	1,30	1,30
	Liftoff weight	t	2,574	2,574	2,574	2,574
	Propellant weight	t	1,895	1,895	1,895	1,895
	Engines		**Rafael**	**Rafael**	**ARC/Rafael**	**ARC/Rafael**
	Propellant		solid	solid HTPB	solid HTPB	solid HTPB
	Total thrust (vac)	kN	58,8	59,3	59,3	59,3
	Specific impulse (vac)	N*s/kg	2864	2898	2898	2898
	Burn time	s	92,5	92,5	92,5	92,5
	Total impulse (vac)	MN*s	**5,4**	**5,5**	**5,5**	**5,5**
Stage 2	**Name**		**TAAS**	**TAAS**	**TAAS**	**TAAS**
	Length	m	5,68	5,68	7,95	7,95
	Diameter	m	1,35	1,35	1,35	1,35
	Liftoff weight	t	10,388	10,388	14,126	14,126
	Propellant weight	t	9,100	9,100	12,750	12,750
	Engines		**ATSM-9**	**ATSM-9**	**ATSM-13**	**ATSM-13**
	Propellant		solid	solid HTPB	solid HTPB	solid HTPB
	Total thrust (vac)	kN	471,1	564	835	835
	Specific impulse (vac)	N*s/kg	2697	2736	2736	2736
	Burn time	s	52	44	42	42
	Total impulse (vac)	MN*s	**24,5**	**24,6**	**34,9**	**34,9**
Stage 1	**Name**		**TAAS**	**TAAS**	**TAAS**	**Castor 120**
	Length	m	5,25	7,52	7,52	10,95 (9,02)
	Diameter	m	1,35	1,35	1,35	2,36
	Liftoff weight	t	10,215	13,990	13,990	53,900
	Propellant weight	t	9,100	12,750	12,750	49,024
	Engines		**ATSM-9**	**ATSM-13**	**ATSM-13**	**Thiokol**
	Propellant		solid	solid HTPB	solid HTPB	solid HTPB
	Total thrust (s.l.)	kN	412,7	552,5	704,5	1.483,7
	Specific impulse (s.l.)	N*s/kg	2334	2363	2452	2481
	Burn time	s	51,5	54,5	44,5	82
	Total impulse (vac)	MN*s	**23,5**	**33,2**	**34,4**	**135,3**



Launcher	Mission	Date	Intern. Design	Spacecraft	Mass (t)
Shavit	LEO	19.09.1988	1988-87	Ofeq 1	0,156
	LEO	03.04.1990	1990-27	Ofeq 2	0,160
	LEO	15.09.1994	failed	Ofeq	0,189
Shavit-1	LEO	05.04.1995	1995-18	Ofeq 3	0,225
	LEO	22.01.1998	failed	Ofeq 4	0,250
	LEO	28.05.2002	2002-25	Ofeq 5	0,300

HAWK

The HAWK system is an aircraft interception surface-to-air missile (SAM) system to short-medium ranges, which compliments the Patriot missile system in its missions. The system, built by U.S. "Raytheon" company was received in the Israeli air force by its Anti-aircraft array in 1965, and had evolved significantly through the years.

In early 1963 an Israeli team headed by haed of IAF's air department, went to the U.S. in order to study about the system, and make proper arrangements for its delivery to Israel. The team consisted of pilots, technicians and some other personnel. After 6 months of training the team moved to the launching stage which was crowned with success. In march 1965 the teams arrived back to Israel with the first HAWK batteries.

The HAWK (homing all the way killer) missile system is the first modern weapon system acquired from the U.S. by Israel. It was the basis for the set up of a modern, well equipped Anti-aircraft array, and was in fact the main reason for the transition of all Anti-aircraft array from the Artillery corps to the Air force.

The approval to the purchase of the HAWK missile system was given only after a personal meeting between Israeli P.M. David Ben-gurion and U.S. president John F. Kennedy. Ben-gurion insisted that Israel was endangered by its arab neighbours as a result of their constant military build-up.

Development

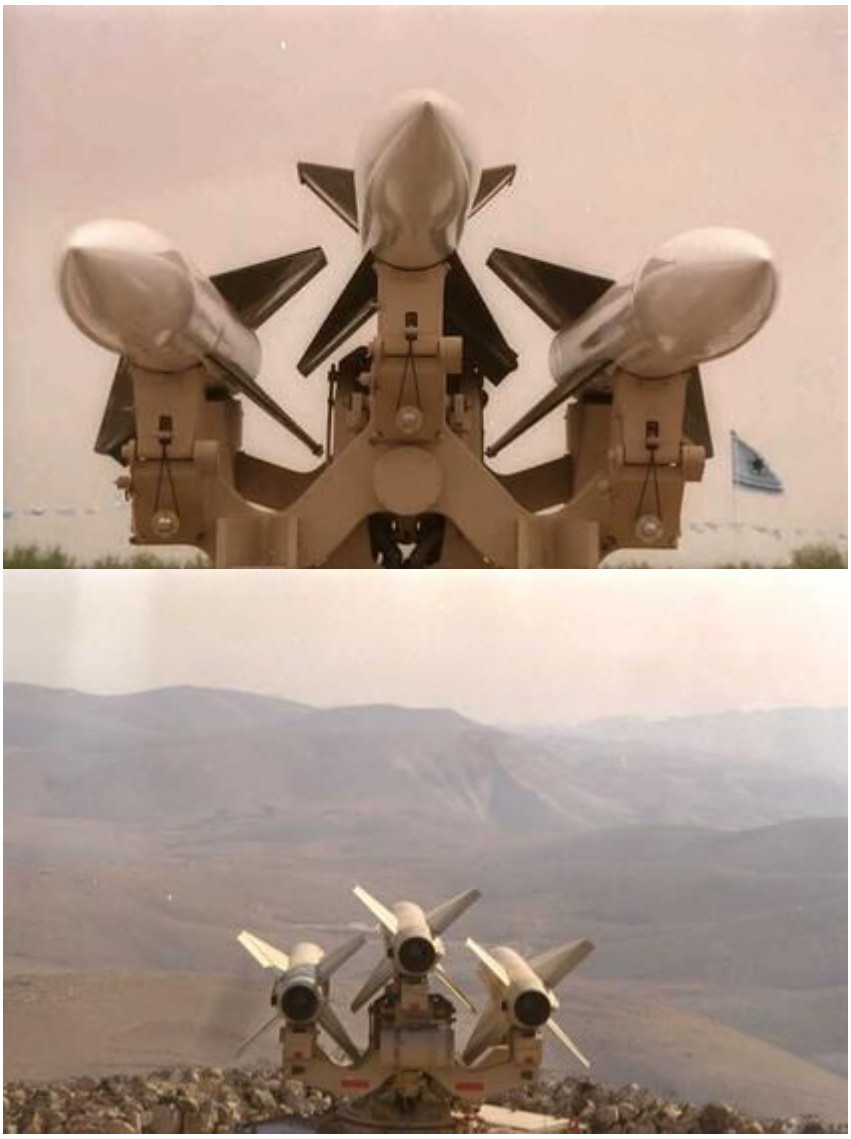
The HAWK missile system consists of a command and control center, a detection and tracking radar, a range radar and a homing center.

The HAWK missile is a single-stage rocket mounted on a launch vehicle, which gives the system a high mobility. The missile has a semi-active guidance system - the missile homes at the target as the radar lights it with a returning radiation. The acceleration and cruise engines are propelled with solid fuel, and the warhead is made of a crushed explosive.

During the years, many changes had been put into the HAWK system, and the present system is quite different from the one that had been deployed in the 60's. The technology had been adapted to counter present threats.

For example, in the 70's an option to skip from deployment sites in short time was added. Also, the analog systems had been replaced to digital ones, improving the missile's performance envelope greatly by increasing its speed and maneuverability, and also shortening its flight and response times.
In the 80's the system's computer was replaced to a faster one, and the radar mastering was improved.
In addition, an israeli unique method extended the missiles' life time by factor of 16.

The HAWK system has some advantages over the Patriot missile system such as performing a 360 degree detecting, occupying and launching, and efficient dealing with low and close targets, at some situations.
It excels in tough terrain deployment, and its low costs enable equipping of a relatively large number of batteries.



PIP-3

In september 1998 , the Israeli Anti-aircraft array converted a first HAWK battery into its most recent evolution - The PIP-3 (product improve project). In april 1999, the first PIP-3 battery was operational.

The project's goal was to adjust the existing HAWK system into 21-century threats and technologies.

The main improvement of the PIP-3 system is its advanced man to computer interface technology, which enables, among other things, a better inner roles distribution.

Also, the new PIP-3 systems utilizes a fully computerized control-trailer, similar to the one installed in the Patriot system. Connectivity to the Patriot system was also one of the goals of the PIP-3 project.
All Israeli HAWK batteries have currently been converted to PIP-3 version.

The HAWK in Battle

Since the its deployment in 1965, the HAWK system has credited 36 aircraft and helicopter hits/downs to itself, which took place during the War of Attrition , Yom Kippur war and Peace of Galilee war.

In the War of Attrition, HAWK batteries were deployed in Sinai in order to reinforce the existing array. In March 21 1969, a first worldwide kill was signed to the HAWK system - Before noon A new HAWK battery, which was deployed at Baluza, north to the town of Kantara in the Sinai region detected , by controller assistant Yariv Geva, an Egyptian Mig-21 aircraft which took off from Port-said airport. Geva alerted the sirens and put the battery in a state of alert. The controller, Yair Tamir, tracked the aircraft on the radar, in its flight from north to south along the Suez canal, and when the Mig-21 broke to a course heading towards the HAWK battery, a missile was launched upon it and it was shot down.

During the War of Attrition, HAWK batteris had shot down additional 10 aircrafts. In the Yom-Kippur war HAWK batteries had shot down 24 aircrafts, and in the Peace of Galilee war, one kill was credited to the HAWK system.

Diameter	36cm
Length	5.03 m
Speed	2 mach
Range	0.5-40 km
Altitude	50,000 ft
Weight	627.3 kg

SPYDER

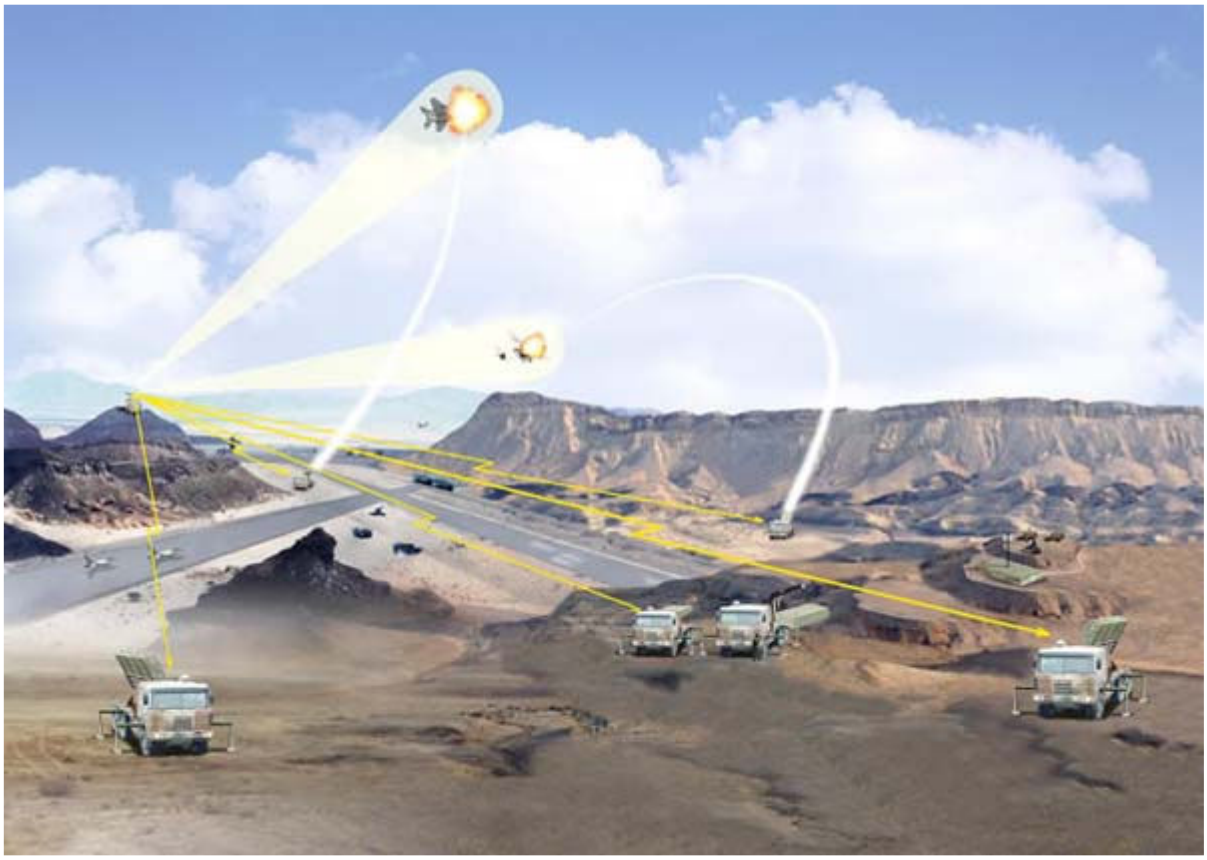
Rafael Armament Development Authority, the MBT Missile Division and Elta Radar Division of Israel Aircraft Industries have announced the SPYDER **S**urface-to-air **PY**thon 5 and **DER**by Air Defence Missile System. Rafael is the prime contractor and IAI the major subcontractor for the SPYDER program.

SPYDER is a low-level quick reaction surface-to-air missile system capable of engaging aircraft, helicopters, unmanned air vehicles, drones and precision-guided munitions. It provides air defence for fixed assets and for point and area defence for mobile forces in combat areas.

The system has 360° engagement capability and the missiles can be launched from the full-readiness state in less than five seconds from target confirmation. The kill range is from less than 1km to more than 15km and at altitudes from a minimum of 20m to a maximum of 9,000m. The system is capable of multi-target simultaneous engagement and also single, multiple and ripple firing, by day and night and in all weather conditions.

SPYDER System Components

The main components of the SPYDER system are the truck-mounted command and control unit, the missile firing unit with Python 5 and Derby missiles, a field service vehicle and missile supply vehicle. The vehicles are air-conditioned and also provide protection against biological and chemical warfare (BCW). The system is based on a modular design and system maintenance in the field is through very quick module replacement.



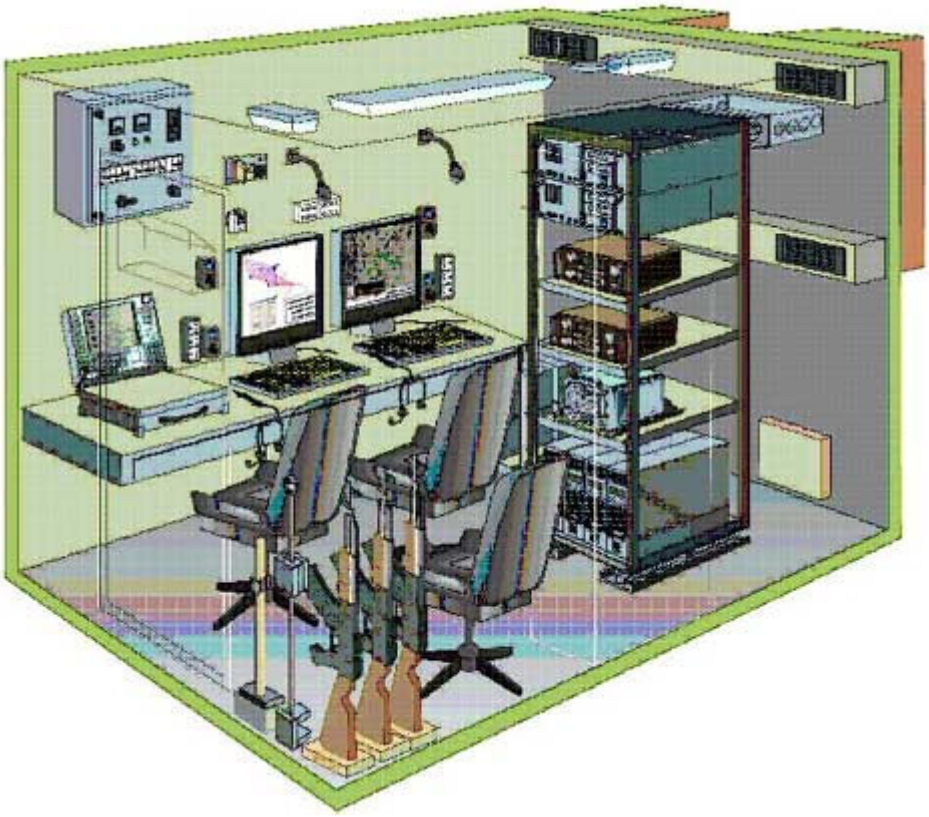
Modes of Operation - Python 5 and Derby Missile Launch

The system can launch missiles in two modes of operation: lock on before launch (LOBL) and lock on after launch (LOAL). The slant launching method, unlike vertical launch, allows LOBL so the missile's on-board seeker is locked on to the target before launch. The LOBL mode allows the Squadron Commander to confirm the missile is locked on to the designated target prior to launch, gives high kill probability against short-range high-manoeuvring targets and enables the engagement of designated targets by add-on optical sensors.

A typical SPYDER squadron consists of one Mobile Command and Control Unit and four Mobile Firing Units. The CCU and MFUs each have their own built-in power supplies. The system features an automated computer, assisting the operators in the successful completion of hostile target interceptions in intense battlefield environments. The mobile CCU is equipped with a surveillance radar and two operator stations. There is a radio datalink between the CCU and the four MFUs.

The CCU combines data from the local surveillance radar and from upper tier command and control centres up to 100km away. There is also provision for receiving Air Situation Pictures from other datalinks. The Air Situation Picture (ASP) is displayed at the operator's workstation in the command centre. When the operator decides to launch, an automatic procedure is initiated. The CCU assigns the target to the appropriate launch unit. If the target is within acquisition range the missile is launched in LOBL mode. If the target is beyond seeker acquisition range the missile is launched in LOAL mode. The seeker searches for the target and switches to homing phase when the target is acquired. Both the Derby and the Python 5 missiles can operate in LOBL and LOAL modes. The target is destroyed by the warhead blasting on impact or by proximity fuze.

Truck-Mounted Command and Control Unit



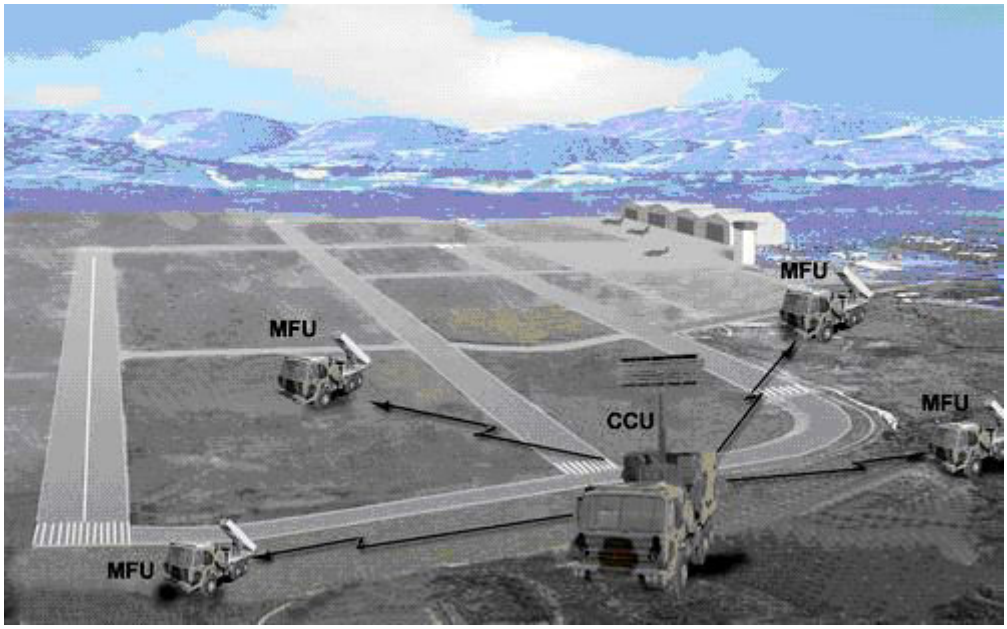
The Command and Control Unit is housed in a truck-mounted shelter with a mounted radar, information friend or foe (IFF) interrogator and communication equipment. The VHF/UHF interference-free communication system is for internal squadron communication and to upper tier command.

Elta EL/M 2106 ATAR 3D Surveillance Radar

The Elta EL/M 2106 ATAR 3D surveillance radar can simultaneously track up to 60 targets. The radar has 360° operation and all-weather day and night capability. The radar includes advanced electronic counter countermeasures (ECCM) for operation in dense hostile electronic warfare environments.

Truck-Mounted Missile Launcher

SPYDER uses a truck-mounted missile firing unit which is equipped with a communications system and fitted with a 360° rotatable, electro-mechanically operated, turret-based launch unit. The launch unit carries any combination of four Python 5 or Derby missiles.



Key Data	
Maximum kill zone range	>15km
Minimum kill zone range	<1km
Maximum kill altitude	9km
Minimum kill altitude	20m
Derby Missile	
Length	3.621m
Diameter	0.16m
Wing span	0.64m
Launch weight	121kg
Range	>63km
Python 5 Missile	
Length	3.0m
Diameter	160mm
Wing span	0.35m
Launch weight	105kg
Range	>15km

Nimrod

Air and Ground Launched Precision Guided Munition (PGM)

Nimrod is an anti-tank and anti-personnel laser homing missile of 26 km range and pinpoint accuracy. It is easily installed on a variety of ground platforms and helicopters.

On land, it provides standoff strike capability against ground point targets such as tanks, APCs, bunkers, personnel concentrations and guerrillas. A forward scouting team uses a laser designator to direct missiles that are fired from a base up to 26 km behind.

Mounted on light vehicles, the system is inherently mobile, and is a natural candidate for rapid-deployment forces. In mobile or fixed shore installations, Nimrod is an excellent coastal defense

weapon.

Nimrod is capable of day/night operation. Its flight trajectory can be set below clouds.

Category	Anti-Armor
Manufacturer	Israel Aircraft Industries
City	Lod, Israel
Length	265 cm
Span	40 cm
Body	18 cm
Weight	100 kg
Guidance	IAI
Guidance Type	Laser-guided
Model	1-stage spr.
Range	26 km

Status	Long range missile in production

LAHAT

Laser Homing Anti-Tank Gun Launched Weapon System

Israel Aircraft Industries, Ltd. (IAI) MBT Division has performed several firing tests, which fully demonstrate the capabilities of the LAHAT system. The system is ready to enter to the pre-production phase.

The system is a gun launched laser guided weapon system which can meet the Anti-Tank and Anti-helicopter mission requirements.

The LAHAT has a highly improved Loss Exchange Ratio compared with the most advanced existing 105/120 mm ammunitions.

The combination of increased effective engagement range and the LAHATs increased first round probability of kill greatly improve a tanks survivability.
The LAHAT system is an add-on system, which requires very minor modifications in the tanks fire control system.

LAHAT is designed to match all types of 105 and 120mm guns, including low recoil guns. Unlike other tank rounds, LAHAT does not need a tank gun for operation, in fact, LAHAT modifications are already considered with:

106mm recoilless rifles
All terrain utility vehicles (Hummer)

Barak

Ship Point Defense Missile System

RAFAEL

BARAK
NAVAL AIR DEFENSE SYSTEM

RAFAEL

Basic Barak Configuration

The Barak Weapon System is a highly advanced ship-borne anti-missile-missile point-defense missile system, as well as an anti-air/anti-surface gunnery control system. The system is highly effective against anti-ship sea-skimming missiles and aerial threats.

First test launch of Barak missile was in 16.8.1991.

Barak employs the vertically-launched Barak missiles and Command-to-Line-Of-Sight (CLOS) radar guidance to counter anti-ship missile and airborne attack by aircraft.

ELTA developed the EL/M-2221 STGR as part of the BARAK-1 Point Defense Missile System for Israeli Navy missile boats.

The System uses advanced radar techniques for target acquisition, target tracking, own-missile tracking and guidance.

The missile Barak is vertically launched, supersonic, lightweight Barak missile that has a very large

and powerful warhead.

The System provides a built-in autonomous capability of tactical picture building and threat evaluation. The System is operated automatically from the detection stage up to the target destruction, while providing the operators with a complete engagements situation picture and allowing their manual intervention.

The flexible modular architecture allows tailoring of the Barak Weapon system according to warship size and Customer requirements with respect to the number of Lines Of Sight (LOS), number of missiles, number of operating consoles, etc.

The Barak Weapon System may also interface with various additional sensors (Surveillance Radars, Electro-Optical Directors etc.), guns and weapons. This extended configuration System can be used as an optimized Combat Management System (CMS) for small and medium size ships.

The System was jointly developed by MBT, ELTA and RAFAEL, according to Israel Navy requirements.

The Barak system is installed and operated successfully on various ships of several navies.

Main Featurs

Vertical launch
Maintenance-free eight-cell launcher
Radar CLOS guidance
Day/night and adverse weather conditions operation
Short reaction time
Very short minimum range
360d/c azimuth coverage
Missile high rate-of-turn

The system provides 360 degrees hemispherical coverage, at 10 kilometers. Barak-1 system, developed in a joint venture between Israel Aircraft Industries and RAFAEL, is based on RAFAE L's vertically launched missile. The Barak system is dedicated to the defence of-naval vessels against subsonic and supersonic anti-ship threats, including aircraft, missiles, smart weapons and UAVS. The highly maneuverable supersonic missile uses a powerful kill mechanism based on a 22kg blast fragmentation warhead, which is optimised to provide a large kill radius against missiles and aircraft. To maintain low altitude effectiveness, the missile uses an altimeter to control the sensitivity pattern of the adaptive fuze, and overcome multipath ambiguities when countering sea-skimming targets.

The rocket motor employs stress relieved, reduced smoke solid propellant to ensure high maneuverability of the missile even at the end of the effective range limit. Barak-1 is optimized against low flying missiles as well as against models supersonic sea skimmers. The system remains fully capable even in an ECCM saturated combat environment. Barak missiles are provided in modular,

vertically positioned container/launchers installed in special compartments provided in the hull. Containers can be rapidly replenished with fresh missiles to maintain combat ready status. A typical configuration includes 8 missiles.

The system employs vertically launched Barak missiles and Command Line Of Sight (CLOS) radar guidance to counter anti ship missile and airborne attacks by aircraft. The systems uses radar techniques for target acquisition, target tracking, missile tracking and missile guidance. For rapid response, the system utilizes built in and autonomous capabilities of tactical picture building and threat evaluation.

The system is operated automatically from the detection stage up to the attack and target destruction phases while providing the operators with a complete tactical and engagement situation picture, allowing manual interference. The Barak-1 system is also integrated with the Threat Alert Radar and the ESM, using a built-in radar tracker to build the ship air and threats picture. The compiled data is evaluated and if needed the system automatically controls the Fire Control Radar (FCR) in ordered acquire and track the threats and launches Barak point defence missiles to defend the ship. The system also provides the kill assessment and decides about the next steps. This is done with full coordination with the Command and Control System and the Decoys Control Launcher System. It can intercept threats at a range of 10 kilometers, down to 500 meters from the ship.

RAFAEL

India, Israel to sign $ 100 mn missile deal

15.48 IST 26th Nov 2003

India and Israel are poised to sign a 100 million dollar deal for the supply of Barak anti-ship missiles for Indian warships despite its recent unsuccessful test launch.

To date the Indian Army has purchased some 260 million dollars worth of Barak missiles from Israel but the upcoming deal with Israeli Aircraft Industries (IAI) will be the Indian Navy's third purchase of the missile.

The surface to-surface Barak missile is produced in Israel and in service with Israeli Navy's Saar 5 patrol boats.

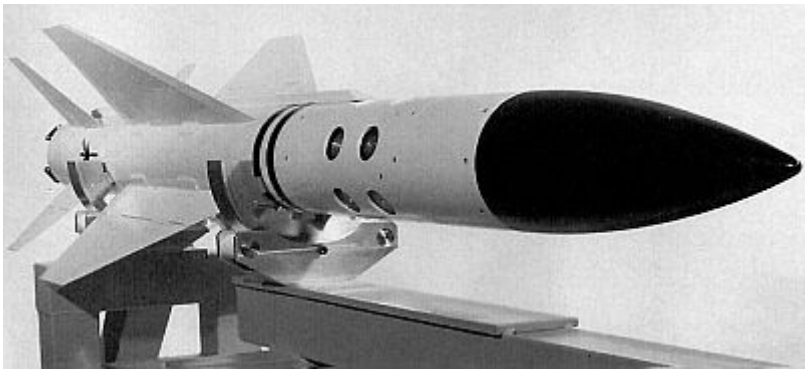
India had first mounted the system on its aircraft carrier INS Viraat.

During a recent test by the Indian Navy veered off course and fell into the sea. It attributed the failure during the launch to problem in communication frequencies between the missile and the warship.

Another possible reason for the failure was a problem in the missile's control and guiding system that stopped the missile's flight, the daily reported.

However, a second missile back-up launched in the same test, hit its target accurately.

India has emerged as one of the largest buyers of Israeli military hardware in recent years and is acquiring the Phalcon earning warning radars. Both sides have also discussed the transfer of the Arrow-2 surface-to-air missiles as part of India's defence against ballistic missiles.



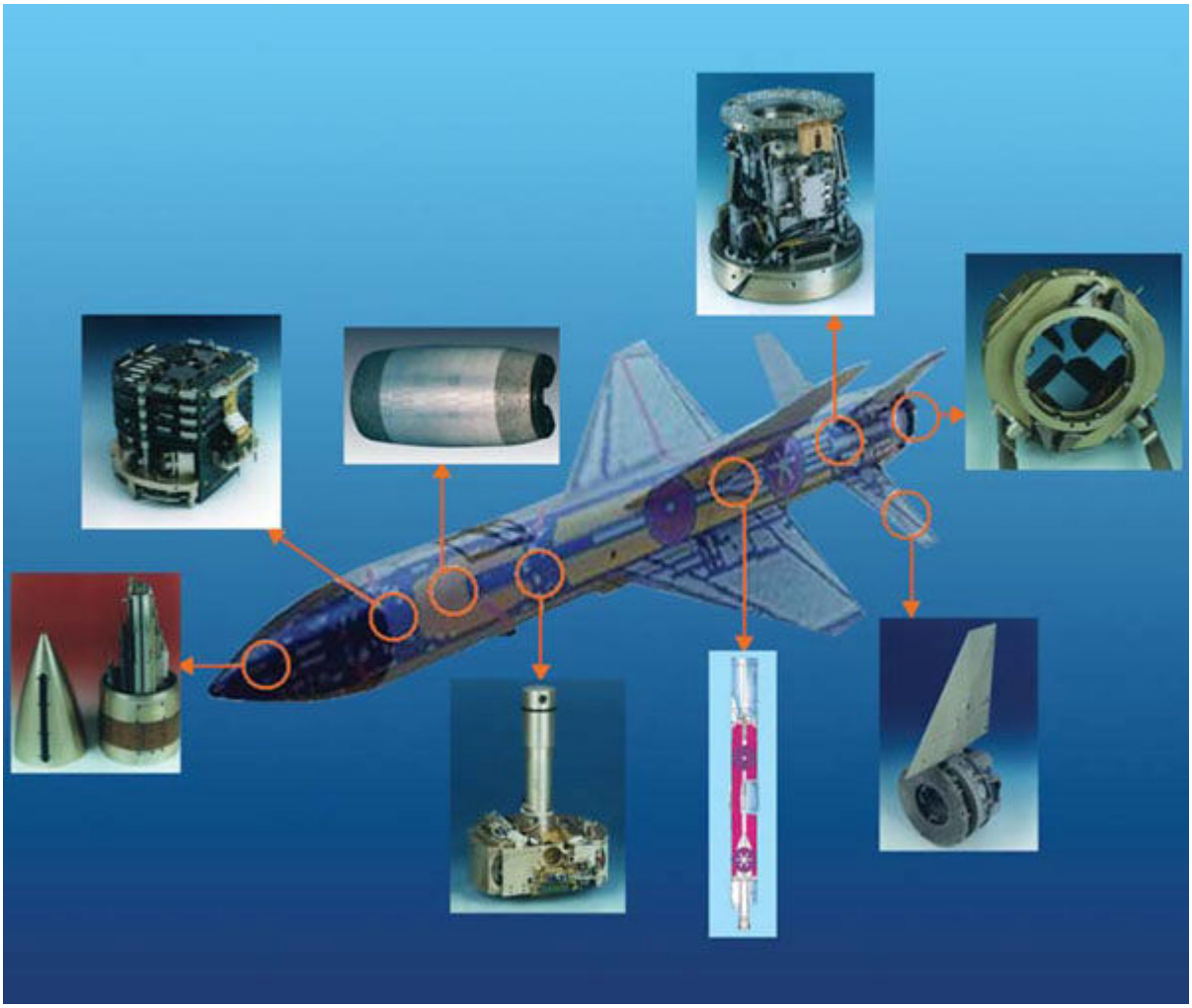
RAFAEL

Missile Parameters

Characteristic	Specification
Length	217.5 mm
Diameter	170 mm
Wing-span	685 mm
Length weight	98 kg
Warhead weight	22kg

Performance Parameters

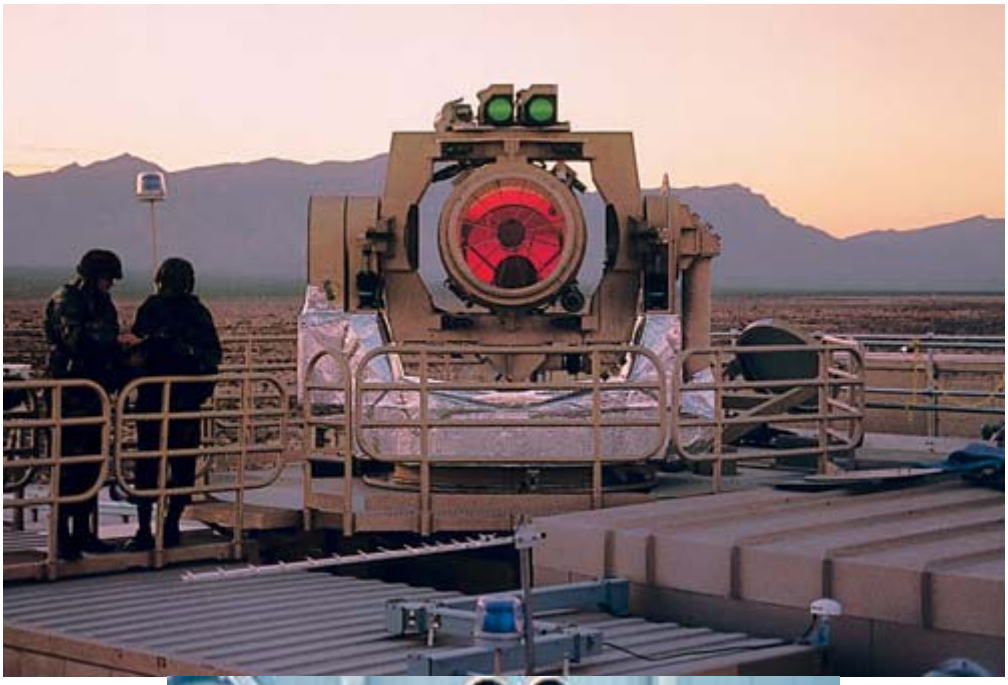
Characteristic	Specification
Maximum velocity	720 m/sec
Maximal effective range	10-12 Km
Minimal effective range	500 m
Maximum Altitude	5.5 km

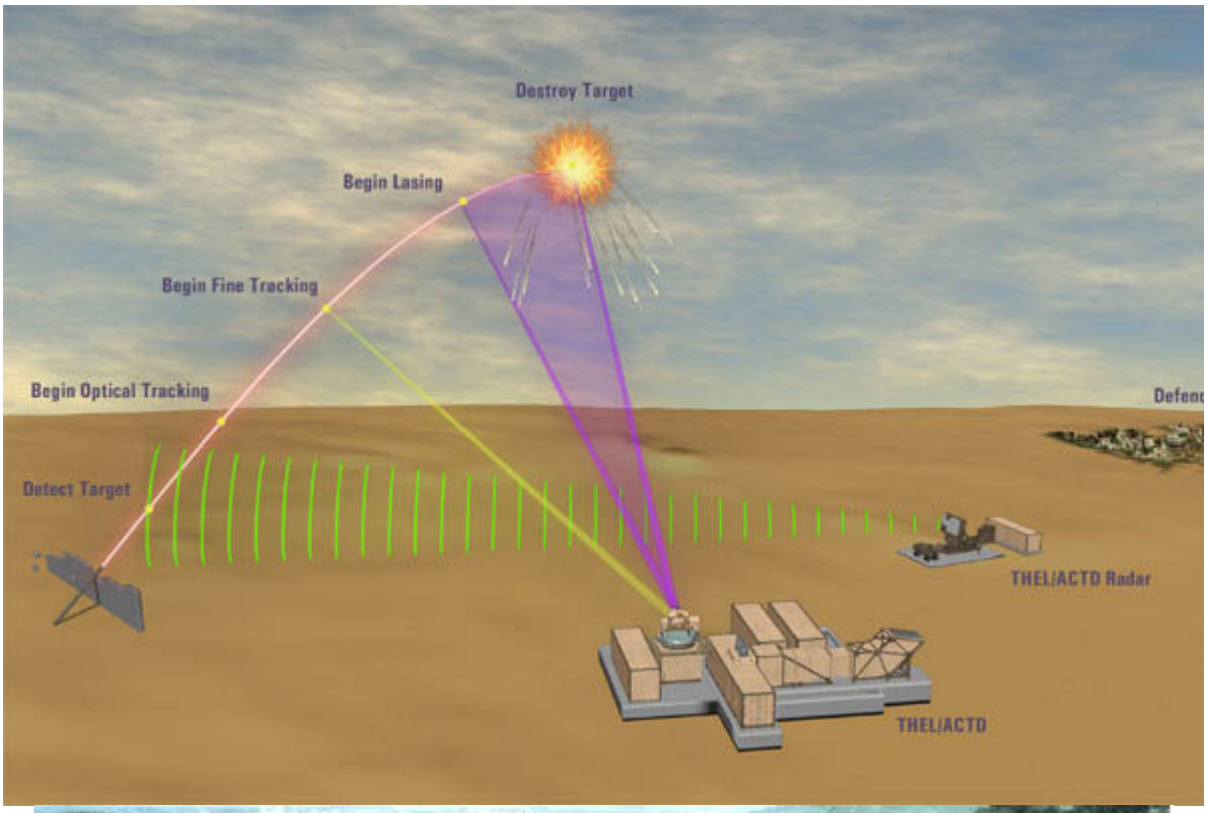


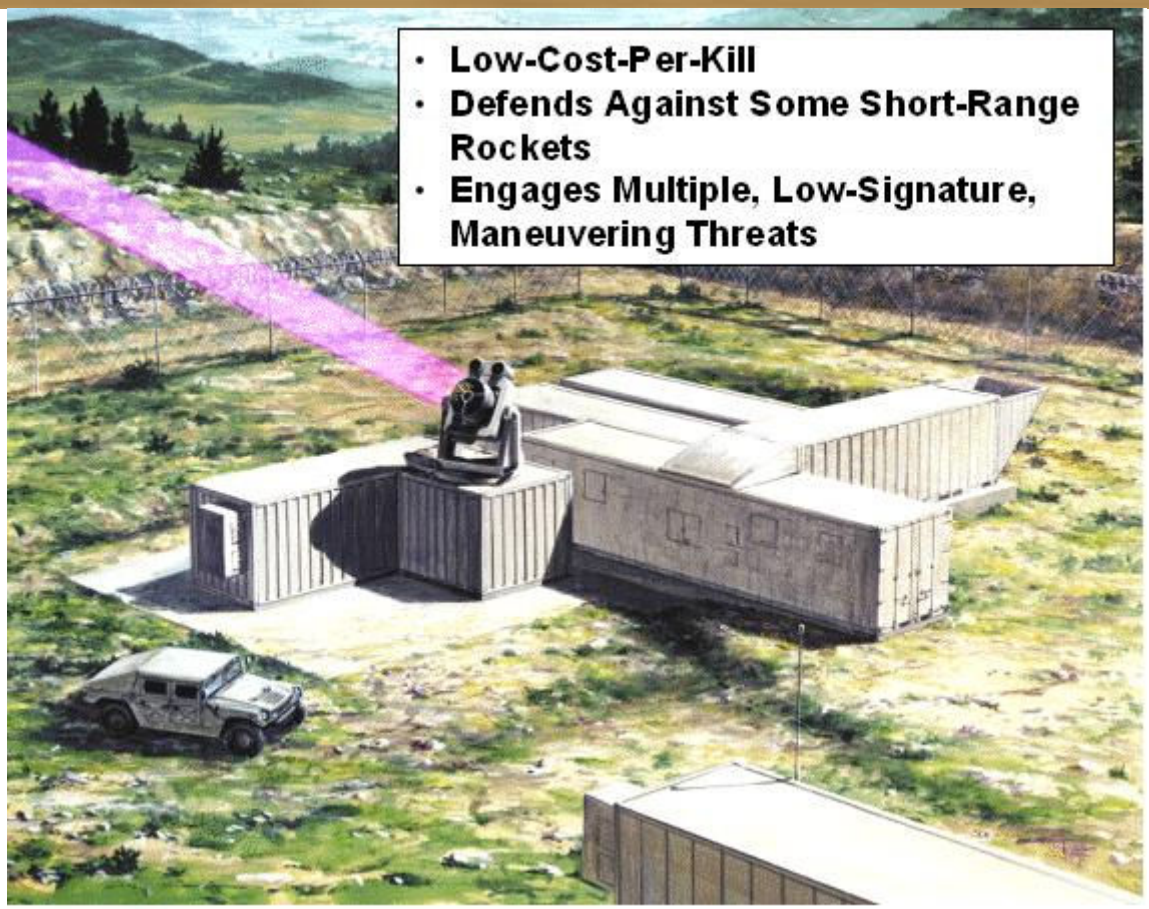
	Barak 1
Length	210 cm
Span	66 cm
Body	18 cm
Weight	98 kg (warhead 22 kg)
Guidance Type	Clos
Model	1 spr.
Range	10 km
Speed	1.7 Mach
Status	Shipborne vehicle launch. Developed with IAI.

LASER

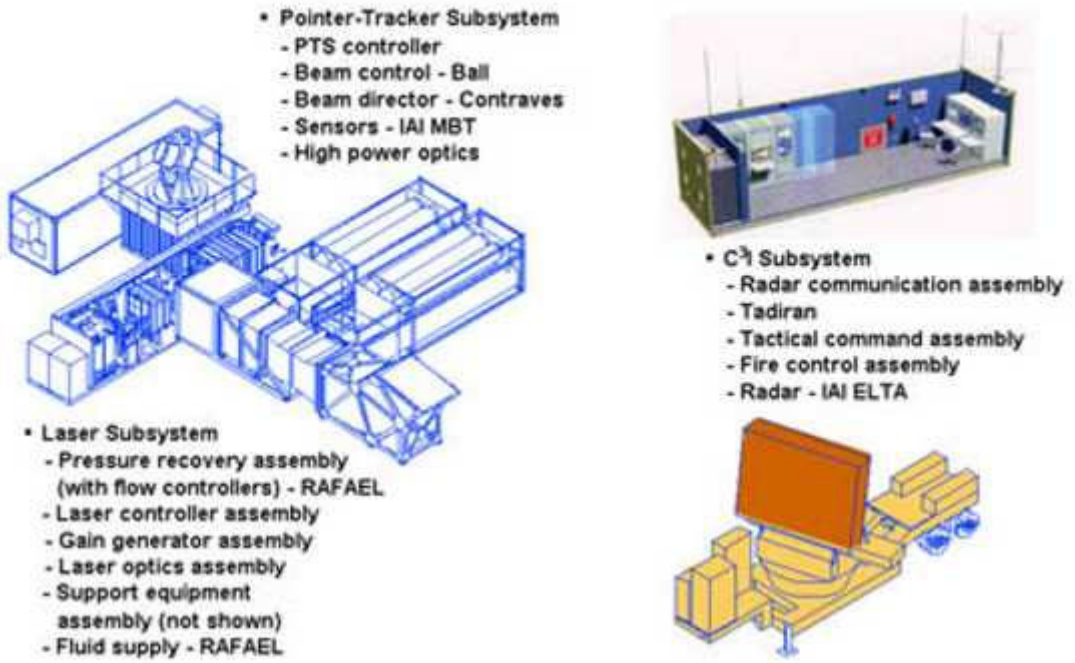
THEL
Tactical High Energy Laser




Destroy Target
Begin Lasing
Begin Fine Tracking
Begin Optical Tracking
Detect Target
THEL/ACTD Radar
THEL/ACTD


• Low-Cost-Per-Kill
• Defends Against Some Short-Range Rockets
• Engages Multiple, Low-Signature, Maneuvering Threats

THEL ACTD Configuration



The Tactical High Energy Laser (THEL) program is a key component of U.S.-Israel strategic cooperation designed to counter short-range rockets. Israel faces a constant threat from Hezbollah-guerillas staging attacks on its northern border. The THEL, still in developmental stages, will serve to protect Israeli troops and civilians in advent of these affronts.The THEL precursor, the Nautilus, destroyed a short-range rocket in flight during testing in February 1996 at a site in New Mexico, nine months after the project was launched. This was the first time a laser has ever destroyed a ballistic missile.

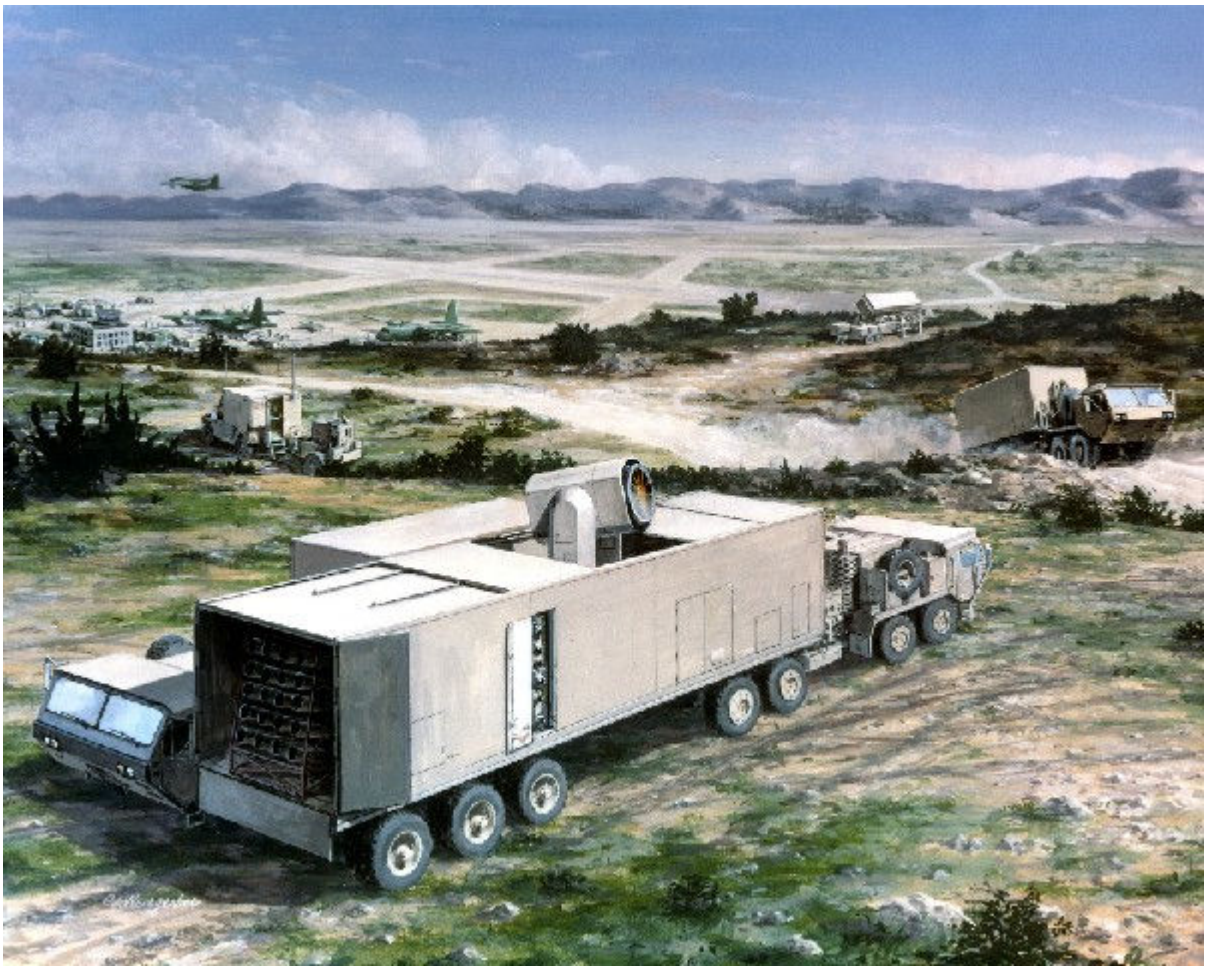
In April 1996 the U.S. agreed to accelerate high energy laser development after Hezbollah guerrillas fired over two dozen of Katyusha rockets at Israel during its 17-day period operation against the terrorists. Soon after, both President Clinton and former U.S. Defense Secretary William Perry have pledged to expand work on the THEL.

THEL will be a transportable laser weapon system which will be used by both the Israeli Defense Forces and eventually will have applications for the U.S. Army. The U.S. Army Space and Strategic Defense Command and the Israel Ministry of Defense are managing the program and the test program is conducted at the High Energy Laser Test Facility (HELSTF) in New Mexico.

The system is capable of intercepting both the Katyushas in the hands of the Hizbullah in Lebanon and the Kassam missiles fired at Israel from Gaza, controlled by the Palestinian Authority. These missiles are also liable to be stationed in the West Bank, from where they could threaten Ben Gurion Airport.

The choice of the Israeli and US companies' concept was a preliminary step in producing an operational prototype of the MTEL, the mobile version of the THEL. Production is scheduled for completion in 2004, and the project is slated to end in 2007.

The laser could be in use in 2007. Since development began in 1996, the Army, the Israeli Defense Ministry and TRW had spent $250 million on the project through 2002.



A fuzzy, green dot from a laser pointer drifts along the ground and comes to rest on an odd-looking piece of metal. For the next few seconds the light hangs motionless. Then, just as we realize the dot is focused on a hand grenade, the image on our viewing screen dissolves in white light. The really impressive sight comes into view when the screen clears. We see that the concrete pad beneath the blast is scorched, but otherwise perfectly intact. "We burn the least explosive part of the munition," explains Scott McPheeters, our guide for a visit to the Army's laser weapons testing center on the sprawling White Sands Missile Range in New Mexico. You may have observed the same low-force blast when as a kid you stupidly tried using a match to light a firecracker that had lost its fuse.

Over the next few minutes we watch the Army's Humvee-mounted Zeus laser cast its glowing eye upon an assortment of unexploded ordnance. Seeing Zeus in action, we realize we are looking at more than a fast new tool for safely clearing unexploded ordnance. We are looking at the first major military breakthrough of the 21st century.

Chemical Lasers

The military began exploring the combat potential of lasers in the 1960s. At that time, researchers focused almost exclusively on chemically activated lasers. Tests at the High Energy Laser Systems Test Facility (HELSTF) here at White Sands have

produced impressive results ever since. As early as 1978, a chemical laser blasted through a tethered helicopter. "MIRACL is a very capable laser," says HELSTF director Tom Hodge, referring to the Mid-Infrared Advanced Chemical Laser, the workhorse of military laser research. "It is also roughly the size of the power and light plant down the road. It isn't a combat system. It is a testbed." Thus far, the most compact chemical laser to score a kill is the Mobile Tactical High Energy Laser (MTHEL), shown here. A few weeks before PM's visit to White Sands, MTHEL became the first laser weapon to track and destroy multiple artillery projectiles in flight at the missile range. The Air Force is using similar chemical laser technology for its Scud-killing airborne laser, which fits inside a modified Boeing 747-400 freighter.

Portable Power

Zeus makes a sharp break with the past. Instead of using highly reactive chemicals to create a laser beam inside a plume of hot gas, Zeus performs its magic inside a special type of glass. Its operating principle is the same as that of all solid-state lasers, including those in CD drives and DVD players. Basically, light from a beefed-up flashbulb sends a stream of photons into nine neodymium-doped glass discs. Inside the discs, the light, which can be thought of as a rabble of raw recruits, becomes organized into a crack drill team--what physicists call a beam of coherent, monochromatic light. Gaining strength as more light is pumped in, the colorless laser beam bursts out one side of the crystal with enough power to heat steel at 200 yards. Add a control system to keep the beam on target and a database that tells the beam which part of the munition to focus upon, and you have the perfect tool for safely defusing unexploded ordnance.

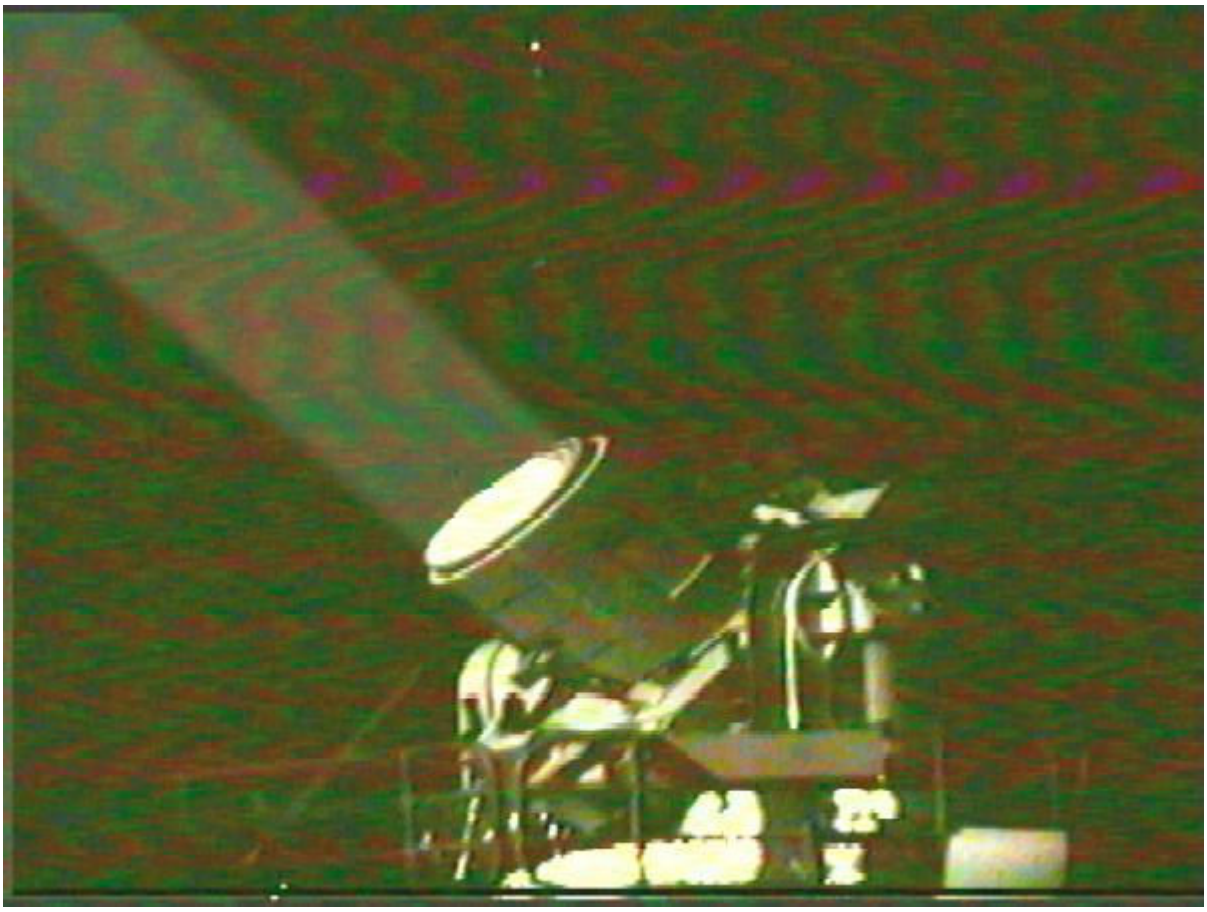
Looking beyond ordnance removal, the Army envisions solid-state heat capacity (SSHC) lasers, such as that used in Zeus, as the ultimate defensive weapon. "Rockets, artillery and mortars cause half of the casualties," says Chip Hardy, SSHC laser project manager at HELSTF.

Senior military officials are more cautious in their assessment. "Our preference would be to walk away from chemicals," Brig. Gen. John Urias, the U.S. Army's point man on lasers, tells PM. He quickly points out that at their current stage of development, solid-state lasers are hardly troublefree. "If the laser overheats, the system shuts down."

Researchers at the Lawrence Livermore National Laboratory in Livermore, Calif., which developed the 10-kilowatt SSHC laser for the Zeus system, believe the power can be increased to the 100 kilowatts needed to blast enemy rockets from roughly 5 miles away.

The difficulty in creating a stronger pulse is not in producing a more powerful laser beam, but keeping the laser itself cool. A 100-kilowatt laser will require 1 megawatt of input power. The heat produced when the laser is fired has to be removed to prevent damage. Livermore scientists have solved the problem by developing a way to rapidly cool the laser between firings without losing its structural integrity or lasing characteristics. A lab spokesman says the research team is on target for delivering a demonstration version by 2007.

THEL Shot Down 25 Katyushas



The Mobile Tactical High-Energy Laser is a short-range weapon being developed with Israel, which wants it to destroy Katyusha rockets fired at its border villages by Hezbollah guerrillas in Lebanon. The weapon looks like a searchlight. In tests during late 2002, the Army used the high-energy laser to heat artillery shells, which exploded in flight. In earlier tests, the laser shot down 25 Katyushas, both singly and in salvos. Artillery shells generate far less heat than rockets do and are more difficult to track. Also, because rockets are pressurized, they are easier to blow up than shells.

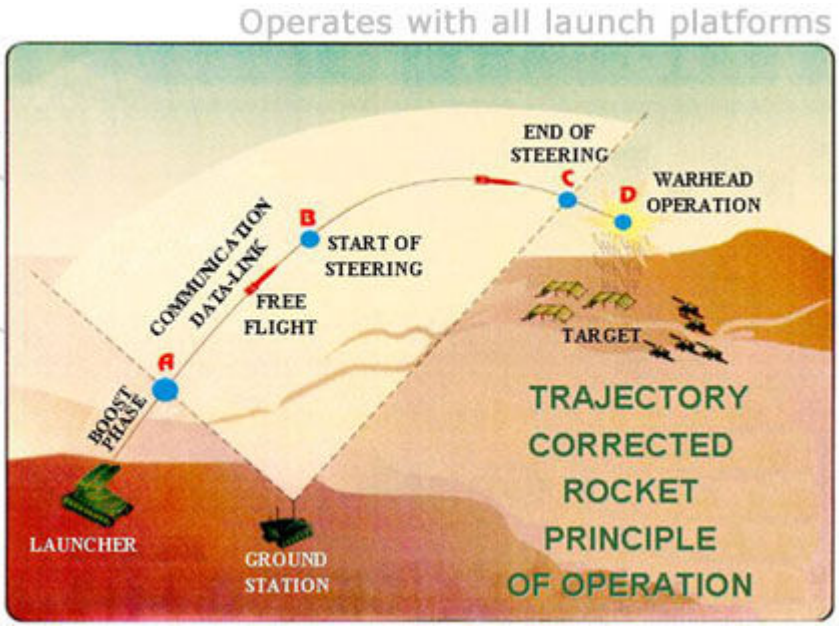
The MTHEL is being designed to protect soldiers from artillery and mortar rounds and rockets. the laser system can be packed into about three tractor-trailer loads, he said. The next phase will shrink it to less than one load. Ultimately, it will be small enough to mount on a Humvee.

THEL Fire Control Radar

Northrop Grumman, the system prime contractor for the U.S. Army's Tactical High Energy Laser/Advanced Concept Technology Demonstrator (THEL/ACTD) program, has successfully completed integration and functional testing of the first THEL/ACTD fire unit at the Army's High Energy Laser Systems Test Facility (HELSTF), White Sands Missile Range, N.M. The THEL/ACTD fire control radar shown in the photo is used to detect incoming Katyusha rocket threats and hand-off trajectory information on each target to the THEL/ACTD pointer tracker subsystem. The fire control radar is a key part of the THEL/ACTD command, control, communications and intelligence (C3I) subsystem.

TCS

Trajectory Correction System

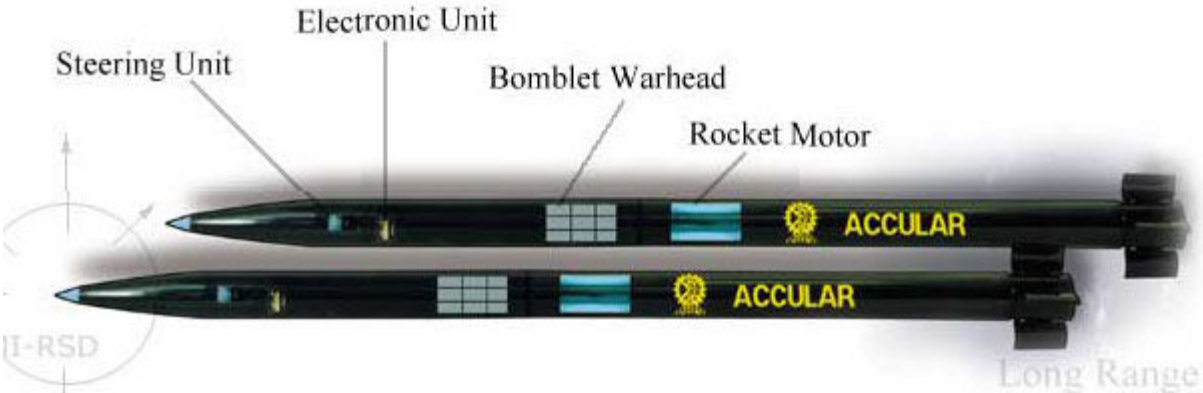


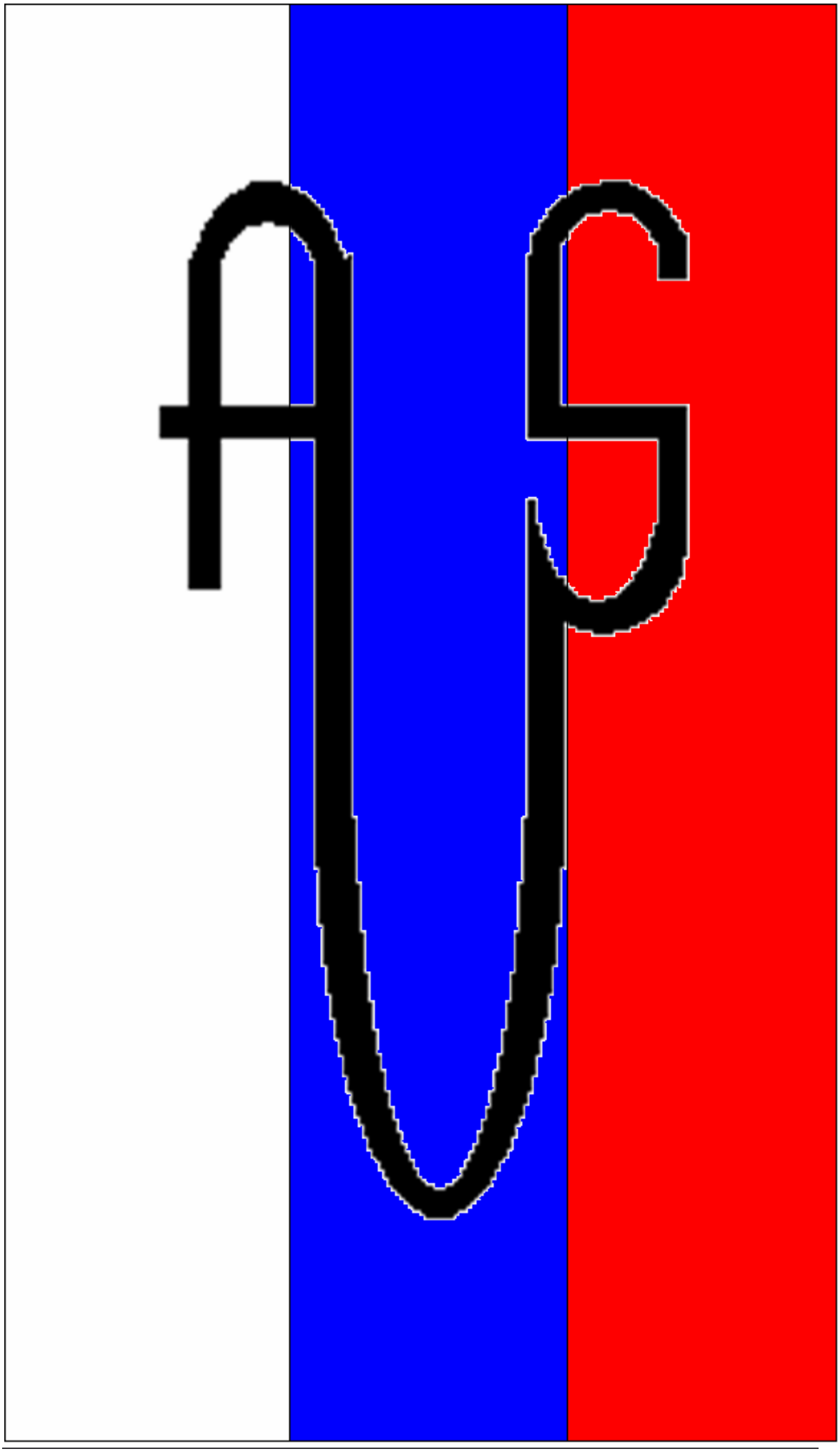
The Trajectory Correction System (TCS) improves the accuracy of free flight artillery rockets to that of conventional tube artillery. By providing in-flight trajectory correction, TCS enables the optimal deployment of smart munitions, such as SADARM or scatterable mines, that require close proximity to the target to be effective. Suitable for implementation on IMI's entire artillery rocket family, it has already been adapted to other artillery rocket systems such as the MLRS

Accular/TCS - Rocket Ammunition

The Trajectory Correction System, known as TCS, is available in the 160mm ACCULAR and in other current production of IMI rocket systems and also as an upgrade to existing systems.
It is currently being supplied as part of the MLRS systems being delivered to the IDF.

A typical TCS system includes a rocket with an electronic package and thrust vector control (for teering the rocket during flight), and a ground control unit. In a TCS mode of operation, the rocket is launched in a free flight mode and the ground system automatically directs the steering-kit of the rocket to continuously correct the trajectory of the rocket to the required path-to-target.





B-300

Anti-Armor Man-Portable Assault Weapon

B-300s a cost-effective weapon system that was developed in the late 1990's. The B-300 is the affordable way to knock out fortified positions in the 15 to 400 meter range. Carried loaded and fired by one soldier, the system features a reusable launcher and a munitions, packed in a launch-container which is discarded after firing. It is simple to operate and requires only a few hours of training to use with deadly effectiveness in all terrain and all weather conditions. Its versatility permits use by airborne, motorized and ground troops.

Simple - little training required; operational within 20 seconds
Portable - carried, loaded and fired by one soldier
Accurate - 50% hit probability
Rugged - ability to withstand adverse environmental conditions & rough handling

Ammunition

Mk 1 HEAT round:
Provides the infantryman with destructive anti-tank capability.

High Explosive Follow:
High Explosive Follow-Through (HEFT) round designed for use in built-up areas against hostile troops inside buildings, behind reinforced concrete, brick or stone walls. A primary charge blows a hole in the wall; the secondary charge passes through it and explodes, destroying everything inside the structure.

B-300/SMAW Rocket Motor

This solid rocket motor was designed and developed for the B-300 shoulder-launched anti-tank / bunker defeat weapon system. A direct derivative was adopted by the US Military for the SMAW personal anti-tank weapon. The Maraging 300 steel motor case is manufactured by hydrostatic extrusion, using both a process and production machinery designed by RSD. To date, RSD has produced over 300,000 of these motors.

Picket

One of the most active and inventive defence manufactur er s in the world today is Israel Aircraft Industries Ltd. Their product line ranges from sophisticated aircraft down to individual weapons. Now the Engineering Division of IAI has brought out the PICKET, a man-portable antitank guided missile. The weapon system is based on a supersonic missile, which is self guided and follows a line-of-sight trajectory. There is no in-flight command guidance, which makes the PICKET invulnerable to electronic countermeasures.

The missile is very lightweight indeed. Designed for shoulder launching, its total weight is 6 kg, and it measures 76 cm in length. Its compactness and the simplicity of operation that it has achieved make it

ideal for short-range use (around 500m) against all kinds of armoured vehicles - i.e., when time is of the essence and just a few seconds difference in getting off one's round can be crucial. Naturally, the PICKET can also be used against fortified positions, at about the same range.

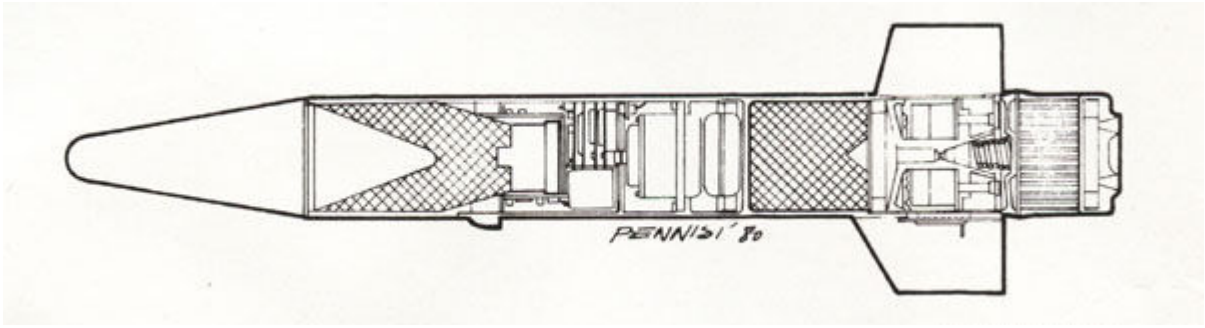
In flight, the missile uses an inertial guidance system. First, the gunner uses an optical sight for target acquisition. With the target lined up, he squeezes the trigger, and in half a second the missile is launched. Since no mid-flight guidance is required, the gunner can "fire and forget"-trigger, wait for the missile to start its flight, drop the launcher and take cover. No adjustment for rage is needed. This is possible because of the flat trajectory. For a moving target, of course, the gunner must be able to lead the target correctly, but this task too is facilitated by the great speed of the missile.

Guidance and Control

The PICKET is directionally controlled, moving along the line of sight at the instant of launching and maintaining that course. The guidance and control system is made up of a gyroscope, an electronics pack, and a thrust vectoring system consisting of four jet tabs. The gyroscope is uncaged about 100 milliseconds after the triggering of the weapon (i.e., just before the launch). From that instant on, the missile is locked on its line-of-sight course.

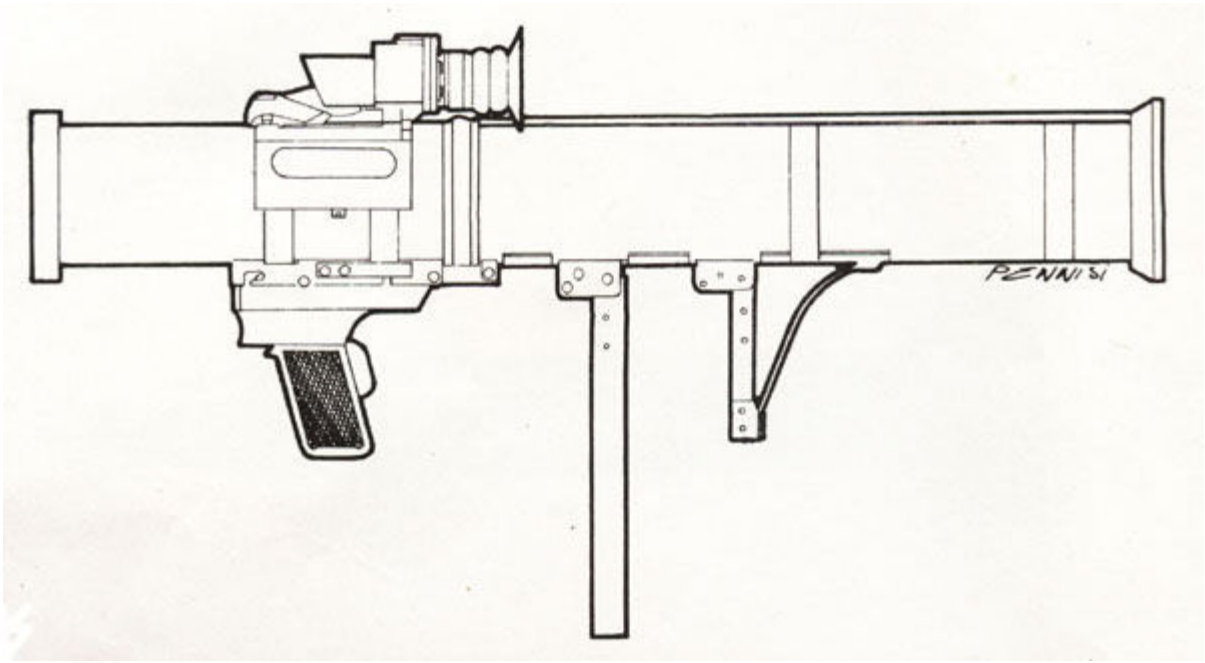
The gyroscope serves to sense and correct angular momentum, due either to the gunner's movement in following the target or to tipoff and crosswinds. With its supersonic speed and its straight trajectory, the PICKET achieves a high hit probability, one of the best in its class.

The Missile



From front to rear, the missile is composed of an armour-piercing warhead, guidance bay, single stage rocket motor, directional control bay, and an ejection rocket motor. Essentially a booster, the latter accelerates the missile up to launch speed and gives it the stabilizing rotational motion. As soon as it is out of the launch tube, the three folding finds open automatically to provide flight stability. Simultaneously the booster is dropped by a spring mechanism, and the cruise motor does not ignite until the missile is a safe distance from the gunner. The cruise motor provides constant thrust throughout the flight. Each missile is carried in an expendable container-launcher.

The Launcher



The PICKET launcher is a smooth fiberglass tube with integral sup-ports and grips. The trigger and are carried separately until the weapon is readied for action. Thus the container has no sharp edges jutting out and is easily transportable, light enough and com-pact enough to be carried by a fully equipped infantryman. A nylon strap allows it to be shoulder-carried.

Deployment

The PICKET can be fired from the prone, kneeling, or upright position, but obviously the prone position

gives the best results. Firing is easy, requiring non complicated operations. There is no control check-list needed. The gunner, after choosing his firing position and selecting his target, puts the various supports in position (either for shoulder support or support on the ground) and clips on the trigger and sight units. The weapon is now ready to fire, and simultaneously pressing the trigger and the safety release lever ignites the booster and starts the launch. Half a second later, the PICKET is on its way. Now the gunner can drop the launch tube.

Unlike many other portable antitank weapons, the PICKET provides for interrupting the launch sequence at any time, unless the trigger has been fully depressed. This means that if the target selected has disappeared, or if another target suddenly presents a greater threat, the gunner, right up to the last instant, can change targets or simply decide not to fire. Thus the PICKET is most flexible in use.

Diameter	81 mm
Length	76 cm
Speed	2 mach
Effective range	500m
Weight	Missile: 4.2kg Launch tube: 1.8kg Total: 6kg
Features	Armour-piercing warhead, inertial guidance with thrust vectoring tabs
Propulsion	Ejection booster and sustainer cruise motor.
The maximum time of flight to the target (500 meter away): 1.2 sec	

SHIPON

Multi Purpose Personal Assault Weapons System

SHIPON

SHIPON is a cost-effective weapon system that was developed in the late 1990's, designed to bridge the gap between low-cost men-served LAR's (Light Anti-Tank Rockets), such as the M-72 LAW, and expensive crew-served ATGM'S (Anti-Tank Guided Missiles), such as the TOW.

The Shipon provides a single infantry soldier with the capability to engage and defeat all modern enemy MBT'S (Main Battle Tanks), including such protected by ERA (Explosive Reactive Armor). In addition, it can be effectively used against various types of targets such as bunkers, armored or non-armored vehicles and different kinds of fortifications.

The rocket has penetration capabilities similar to these of 2nd and 3rd generation ATGM'S, while it's as cost-effective and simple to handle as a LAR (a single soldier can carry and operate the system by himself). Moreover, advanced FCS (fire control system) and dual stage propulsion enables the operator to engage targets as far as 600 meters away from him with a 50% hit probability.

Technological Improvements Over Conventional Infantry Weapons:

Tandem warhead
Automatic advanced fire control:
- Range finder
- Cross-wind measurement along trajectory to target
- Temperature measurement
- Inclination

Range - Up to 600 m (at 50% hit probability)
Armor Penetration - 800 mm armored steel shielded by ERA (Explosive Reactive Armor)
Structure - Reusable FCS and Firing Mechanism Disposable Canister
Fire Control - LRF, Cross-wind, Inclination, Moving Target

Ammunition

Outstanding versatility is provided by two dedicated dual mode warheads.

Anti-Tank/Anti-Fortification Tandem Warhead:
Penetrates 800 mm of armored steel (reactive armor protected), or 500 mm of reinforced concrete.

Anti-Fortification/Anti-Personnel Tandem Warhead:
In anti-fortification mode, front charge penetrates reinforced concrete and main charge explodes inside structure. In anti-personnel mode, front and rear fragmentation charges separate at optimal height and explode above target.

Gill/Spike

Rafael based in Haifa, Israel, manufacture the Spike family of anti-armour weapons. The weapons are lightweight fire-and-forget anti-tank missiles and use electro-optical and fibre-optic technologies. The systems are used by infantry soldiers, special rapid reaction forces, ground forces and helicopter aircrew.

The Spike family includes the Gill and the Spike missiles and is currently in production and in service with the Israeli Defence Force and with the Singapore Armed Forces. In November 1998, Rafael signed a co-operation agreement with EuroSpike (STN ATLAS, Diehl and Rheinmetall) to market, produce, sell and maintain Rafael's anti-armour systems, including the Gill and the Spike in certain European markets. Rafael have also signed an agreement with MBDA (formerly Matra BAe Dynamics) to address the British and some other European and overseas markets.

In May 2000, the Finnish Army selected a version of the Spike system, Spike 2.5, to meet its requirement for a medium-range anti-tank missile system. STN Atlas will produce the launchers, Diehl the munition and Rheinmetall the warhead.

In August 2001, the Netherlands Ministry of Defence ordered the Gill missile system to replace the Dragon missile of the RNl Army and Marine Corps. Rafael is the prime contractor, with STN Atlas, Diehl and Thales Nederland (formerly Signaal) the major subcontractors.

The UK Defence Procurement Agency has purchased a number of Spike missile systems for trials and has issued an Invitation to Tender (ITT) to MBDA and to Javelin Joint Venture for the Javelin system, for the Light Forces Anti-Tank Guided Weapon System (LFATGWS) requirement. A decision on selection is expected in 2002.

In July 2002, Poland selected the missile system with deliveries planned to begin in 2003. Local production by ZM Mesko is expected to form part of the contract terms

System

The Spike's thermal Command Launch Unit (CLU).

The Gill and the Spike have the same firing post. The firing post consists of the Command Launch Unit (CLU), the thermal imager and a tripod. The Gill, the shorter range version, is a portable fire and forget anti-armour missile system with a range up to 2.5 kilometres. The Gill uses a charge coupled device (CCD) seeker for day time use or an imaging infrared (IIR) seeker for day and nightime use. Gill can fly with a lofted trajectory enabling the tandem warhead to hit the target at the most vulnerable point. Spike is a portable anti-armour weapon system with a range up to 4 kilometres, which can be operated in fire-and-forget mode and in fire, observe and update mode for non-line-of-sight (NLOS) operations using the fibre optic data link. One soldier can carry two missiles in the back pack and the total system weight is 26 kg.

The thermal sight unit used with the SPIKE system.

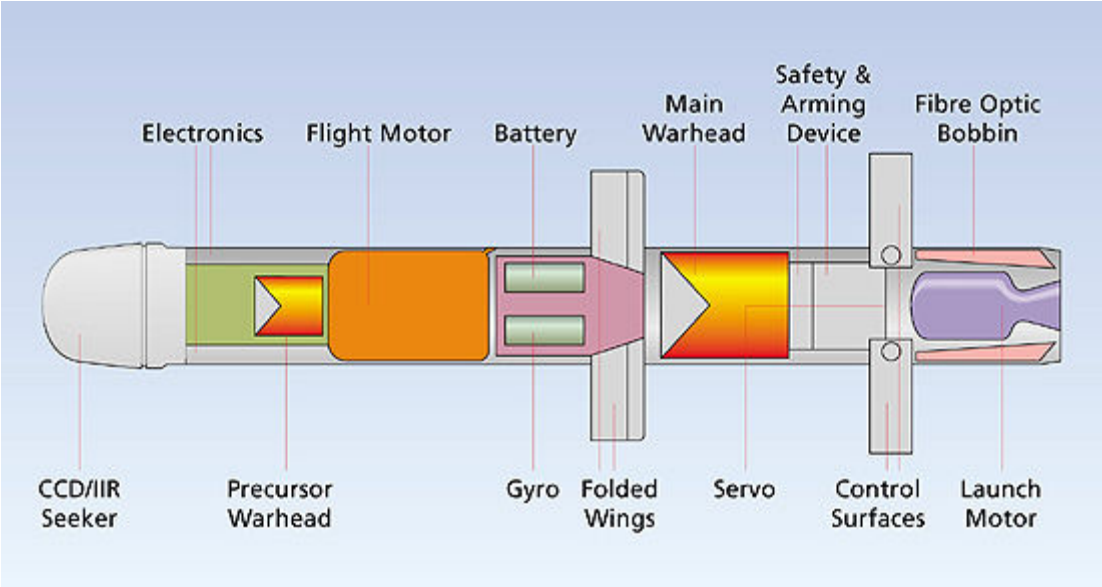
Operation

The system is made ready to fire in less than 30 seconds. The soldier acquires the target and lays the cross hairs of the sight on the aim point on the target using either the day sight with a 10 times magnification and 5 degree field of view or the clip-on thermal imaging night sight with wide and narrow fields of view.

The soldier activates the missile, locking the tracker on the target and he pushes the Fire button to launch the missile. The missile automatically propels itself towards the target without any additional interaction and this fire and forget capability allows the soldier the option of relocating to a new firing position or to reload immediately for the next engagement. Reloading takes less than 15 seconds.

After launch the missile follows a lofted trajectory and as it approaches the target it dives down to impact the target. The lofted trajectory and the tandem high explosive warhead enables the missile to penetrate tanks equipped with explosive reactive armour (ERA).

Missile



The missile has four rectangular fins for aerodynamic control at the rear, and four wings at just over halfway from nose to tail on the length of the body. They unfold as the missile leaves the launch cannister.

The guidance system in the nose of the Gill-Spike missile comprises a charge coupled device (CCD) and Imaging Infra-Red (IIR) seeker. The imaging infrared provides higher sensitivity and improved thermal background rejection characteristics for all weather day and night operation. Gill has a range up to 2,500 metres.

Traning

The Gill-Spike training programme includes target identification and acquisition, missile lock-on and post launch observation. The Gill-Spike system has two simulators for individual training. The Outdoor Simulator trains soldiers, using real targets, up to the point of missile launch. The Indoor Trainer also trains soldiers up to the point of missile launch and during missile flight using the fibre optic data link

The Missile Family

The SPIKE Family consists of missiles suited for several platforms, multiple ranges and a variety of targets. The missiles in this family have sophisticated electro-optic CCD or IR sensors for operation day and night and in adverse weather conditions and a tandem warhead. Their lofted trajectories enable the warhead to hit the target at its most vulnerable part with pinpoint precision. All of the SPIKE Family members have a low Life Cycle Cost, due to high reliability and operational, logistic support and production commonality between members.

Designation	Max. Range	Application
SPIKE-SR	800m	Infantry
SPIKE-MR (Gill)	2,500m	Infantry and Special Forces
SPIKE-LR (Spike)	4,000m	Infantry, Light Combat Vehicles
SPIKE-ER (NTD)	8,000m	Infantry, LCV, Helicopters

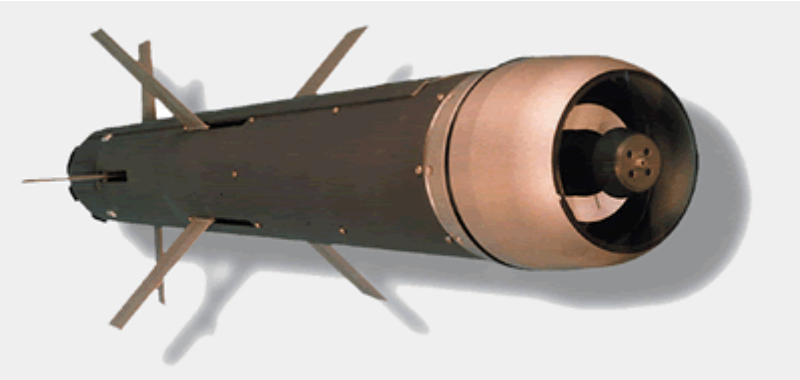
SPIKE-SR Short Range Anti-Tank Weapon

The SPIKE-SR is a low cost, Fire and Forget, man portable, short range, guided missile system that is highly lethal against various targets.

Features:

Range: 50 - 800 meters
Fire and Forge
Operation from confined spaces
Two-stage warhead
Easy target lock-on
Lightweight system (9kg)
Maintenance Free

SPIKE-MR (Gill) Medium Range Anti-Tank Weapon



The SPIKE-MR is a lightweight, man-portable, Fire and Forget, multi-purpose missile system with a range of up to 2,500 meters. Its Fire and Forget operational mode guarantees maximum gunner survivability and high hit probability. The SPIKE-MR has an optional Fire, Observe and Update mode of operation for the modern, multi-faceted battle.

The "Gil" is a personal, third generation, "fire and forget, missile. The "Gil" is able to receive data subsequent to its launch, and is capable of switching targets while in flight.

The "Gil" is one of the most advanced missiles in the world, and was developed by the Rafael arms industry in cooperation with the IDF during the 1990's.

The advent of the "Gil" revolutionized the Israeli arms industry, as the IDF had previously relied on the "Orev" and "Gavnoni" anti-tank missiles. Currently, the IDF bases its anti-tank capabilities primarily on the "Gil" type anti-tank missiles.

Technical Details

1) Versatility: The missile can be adapted to naval, aerial, and land platforms.

2) Range: Range of 2.5 km.

3) The warhead seeker: The warhead seeker is electro-optical (TV) and enables tracking as well as pinpoint target acquisition. In addition, the "Gil's" fiber-optic communcations system allows for the collection of vital intelligence gathering, the ability to seek hidden targets, and prevents firing against targets which have been previously destroyed.

4) All weather capability: The missile operates in all weather conditions and in nocturnal scenarios.

The ability of the "Gil" to operate in the above-mentioned conditions represents a signifcant technological advance.

5) Tandem (double) warhead: The tandem double warhead allows for increased penetration, especially against reactive armor, and enables the second warhead to penetrate the target.

6) Fire and forget capability: Automatic target guidance.

7) Fire and optic capabilities: This includes the ability to update target information and to switch between targets during a flight.

8) Vertical assault trajectory.

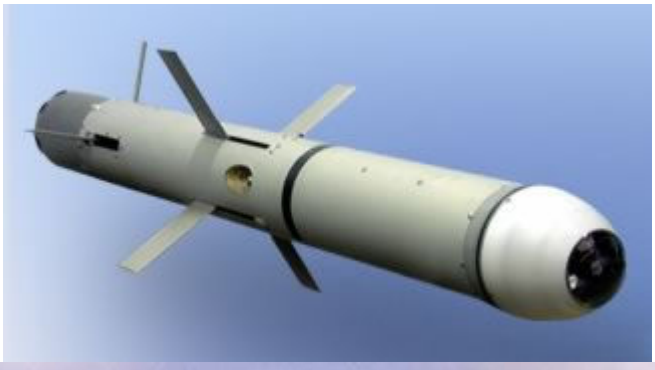
9) Fiber optic communication.

10) Lightweight: Each infantry soldier can carry up to two missiles on his back.

Effective range	200 - 2,500 meters
Weight	
Missile in canister	13 kg

Firing post	9 kg
Battery	1 kg
Tripod	3 kg
Total system weight	26 kg
Operation	Fire and Forget Fire, Observe & Update (optional)
Seeker	Electro Optical (CCD, IR or Dual CCD/IIR)
Shelf life	20 years
Wooden round	10 years maintenance free
Ready to fire	less than 30 seconds
Reload time	less than 15 seconds

SPIKE-LR (Spike/Gill) Anti-Tank Weapon



The SPIKE-LR is a lightweight, Fire and Forget and Fire, Observe and Update, multi-purpose missile system with a range of up to 4,000 meters. State-of-the-art seeker and fiber-optic data communication link provide SPIKE-LR with the unique ability to:
Update or switch targets after launch
Achieve real-time intelligence and identify friends or foe
Perform battle damage assessment
Achieve extended range and pinpoint accuracy
Minimize collateral damage
The "Gil" is a personal, third generation, "fire and forget, missile. The "Gil" is able to receive data subsequent to its launch, and is capable of switching targets while in flight.

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The missile:
As well as the fire and forget seeker guidance, the Spike missile is equipped with a fibre optic data link guidance system which sends commands to the missile from the launch system and receives, into the gunner's field of view, images from the seeker. The gunner can update his aim point while the missile is in flight using the fibre optic link. The gunner maintains tracking. The Spike system can work in non line-of-sight (NLOS) mode allowing the gunner to operate from a covered position. Spike which can be installed on a range of platforms can be used to engage tanks, armoured vehicles, hardened shelters and low flying slow targets such as helicopters.

Technical Details

1) Versatility: The missile can be adapted to naval, aerial, and land platforms.

2) Range: Range of 4 km.

3) The warhead seeker: The warhead seeker is electro-optical (TV) and enables tracking as well as pinpoint target acquisition. In addition, the "Gil's" fiber-optic communcations system allows for the collection of vital intelligence gathering, the ability to seek hidden targets, and prevents firing against targets which have been previously destroyed.

4) All weather capability: The missile operates in all weather conditions and in nocturnal scenarios. The ability of the "Gil" to operate in the above-mentioned conditions represents a signifcant technological advance.

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8) Vertical assault trajectory.

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10) Lightweight: Each infantry soldier can carry up to two missiles on his back.

Effective range	200 - 4,000 meters
Weight	
Missile in canister	13 kg
Firing post	9 kg
Battery	1 kg
Tripod	3 kg
Length with canister	1200 mm
Operation	Fire and Forget Fire, Observe & Update

Shelf life	20 years